Petrochemical

Oxygenates in Gasoline - D4815 Valve &

DPS Instruments, Inc.

www.dps-instruments.com

With the dramatic increase in reformulated gasoline production around the world there is an ever increasing demand for the analysis of oxygenates, which are added boost the octane value of these fuels. The DPS Oxygenates GC System uses a polar TCEP pre-column to separate the oxygenates from early eluting hydrocarbons, then back-flushes the retained oxygenates to a high resolution capillary column for separation. Both columns are connected through a 10-port valve and the entire sequence is automated through the Timeline in the DPS Control Software. The identification and quantitation and are performed using a sensitive FID detector following ASTM D4815 guidelines. The DPS Oxygenates GC System is configured to quickly detect these oxygenates in less than 15 minutes. The fast heating and rapid cooling column oven in every DPS GC assures rapid sample turnaround. The fully integrated Oxygenates GC Systems are small and lightweight and all DPS systems are modular for expandability, upgrades, and easy service.

Available Configurations Include:

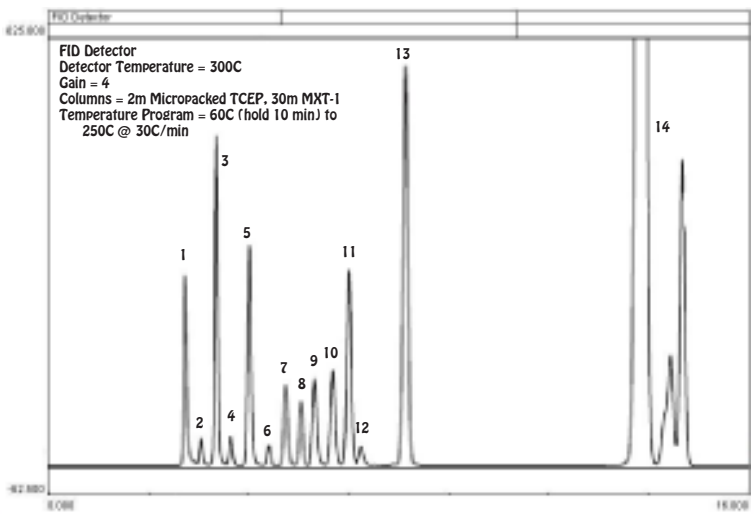
600-C-089 - Series 600 Oxygenates GC Analyzer (FID, Valve, 2m & 30m)
500-C-089 - Companion 1 Portable Oxygenates GC Analyzer
(FID, Valve, 2m & 30m)

Series 600 GC

Companion 1 Portable GC

Oxygenates in Gasoline

Peak	Component
1	Methanol
2	Ethanol
3	Isopropanol
4	Tert-Butanol
5	n-Propanol
6	MTBE
7	sec-Butanol
8	DIPE
9	Isobutanol
10	tert-Pentanol
11	DME
12	n-Butanol
13	TAME
14	Heavier Hydrocarbons



3/2019
Specifications may change without notice.

Petrochemical

Permanent Gases + Sulfur 2

DPS Instruments. Inc.

www.dps-instruments.com

The DPS Perma-gas 1 Plus Sulfur GC System is ideal for separating the whole gas components Hydrogen, Oxygen, Nitrogen, Methane, Carbon Monoxide and Carbon Dioxide with one injection. Additionally, H2S and C2 through C6 hydrocarbons are easily separated in the same analysis. The sensitive and universal Helium Ionization Detector (HID) from DPS and our innovative 2 column and valve configuration simplifies this analysis. The DPS Perma-gas 1 + Sulfur GC Systems are ideal for ppm level measurements in your high percentage gas samples. Perma-gas 1 + Sulfur GC Systems can be built into our Series 600 Lab GC, or the Portable Companion 2, allowing you to take the analyzer with you into the field. Only a small tank of Helium is need to operate the GC System. The fast heating and rapid cooling column oven in every DPS GC assures rapid sample turnaround. The fully integrated Perma-gas 1 + Sulfur GC Analyzer Systems are small and lightweight and all DPS systems are modular for expandability, upgrades, and easy service.

Available Configurations Include:

600-C-073 - Series 600 Perma-Gas 1 + Sulfur GC Analyzer (HID, PID, Valve, 3 Columns)

500-C2-073 - Companion 2 Portable Perma-Gas 1 + Sulfur GC Analyzer (HID, PID, Valve, 3 Columns)

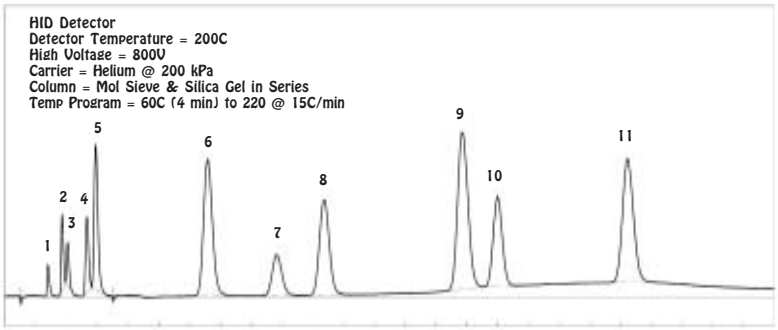
Series 600 GC

Companion 2 Portable GC

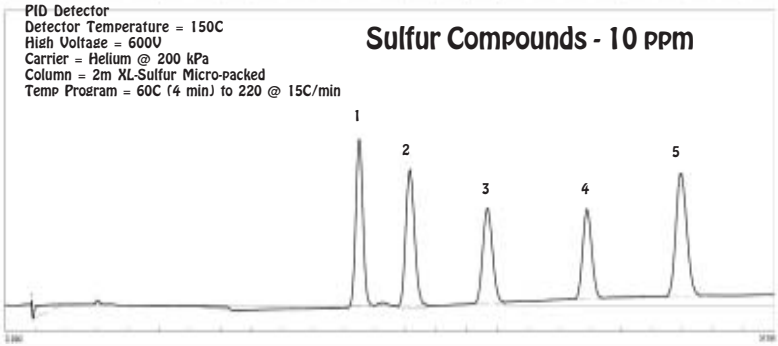
Peak	Component
1	Hydrogen
2	Oxygen
3	Nitrogen
4	Methane
5	Carbon Monoxide
6	Ethane
7	Carbon Dioxide
8	Ethylene
9	Propane
10	Acetylene
11	Propylene

Peak	Component
1	Hydrogen Sulfide
2	Carbonyl Sulfide
3	Methyl Mercaptan
4	Dimethyl Sulfide
5	Dimethyl Disulfide

Permanent Gases & Hydrocarbons - 1000 ppm



Sulfur Compounds - 10 ppm



11/2020
Specifications may change without notice.

Petrochemical

Bio-Fuels Methanol & Ethanol

DPS Instruments. Inc.

www.dps-instruments.com

With the dramatic increase in biofuels production around the world there is an ever increasing demand for the analysis of Methanol and Ethanol in these fuels. The classical method for analysis, ASTM Method D5501 uses very long columns (100 or 150m) to adequately separate these alcohols from other interfering compounds in these complex fuel mixtures, with run times of about 40 minutes. Many plants require the Ethanol content of the denatured fuels be analyzed before the fuel is transported, which is difficult with such long run times. The recent development of capillary columns for biofuels separations has helped tremendously. The DPS Alcohols GC System is configured with the latest designed high resolution capillary column and the sensitive FID detector to quickly detect these compounds in less than 10 minutes. The fast heating and rapid cooling column oven in every DPS GC assures rapid sample turnaround. The fully integrated Alcohols GC Systems are small and lightweight and all DPS systems are modular for expandability, upgrades, and easy service.

Series 600 GC

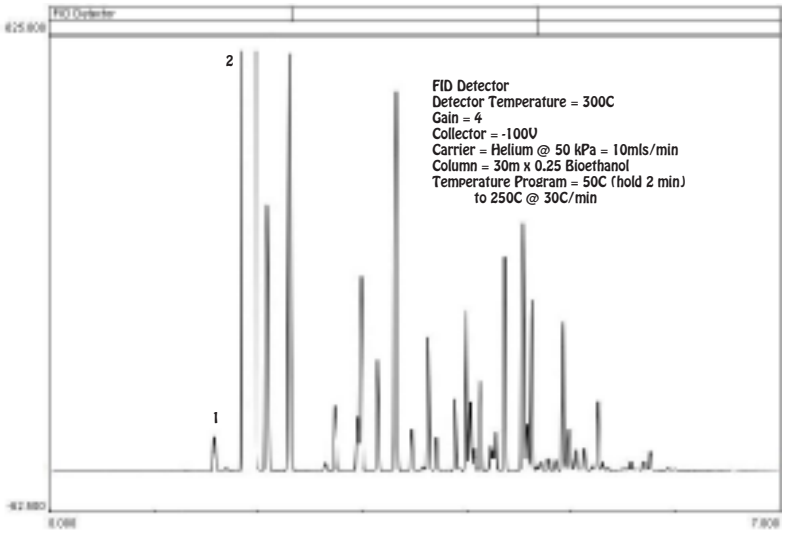
Available Configurations Include:

600-C-111 - Series 600 Alcohols GC Analyzer (FID, 30m)
500-C-111 - Companion 1 Portable Alcohols GC Analyzer (FID, 30m)

Companion 1 Portable GC

Methanol & Ethanol in Gasoline

Peak	Component	Area
1	Methanol	247.3
2	Ethanol	2173.5



5/2017
Specifications may change without notice.

Petrochemical

Sulfur Compounds

Instruments, Inc.

www.dps-instruments.com

The analysis of sulfur containing compounds in petroleum products is drawing more attention around the world as governments are passing regulations for products with lower sulfur concentrations, which lead to lower sulfur emissions. There are a host of problems associated with the sampling and analysis of sulfur compounds. First and foremost is that sulfur compounds degrade on metal surfaces, especially hot metal; making sulfur compounds difficult to store. Secondly, you need to differentiate them from the hydrocarbon mixtures for analysis. The DPS Sulfur GC Analyzers answer these problems with an inert sample path, free of hot metal surfaces, the latest analytical column technology, and the sensitive FPD detector. The DPS Sulfur GC Systems are ideal for your complex hydrocarbon mixtures requiring sensitive sulfur measurements. The fast heating and rapid cooling column oven in every DPS GC assures rapid sample turnaround. The fully integrated Sulfur GC Analyzer Systems are small and lightweight and all DPS systems are modular for expandability, upgrades, and easy service.

Series 600 GC

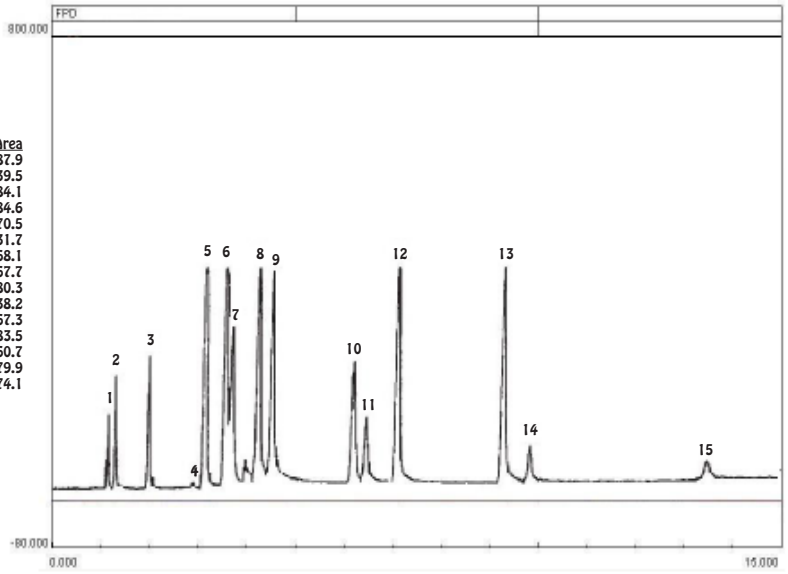
Available Configurations Include:

600-C-095 - Series 600 Sulfur Compounds GC Analyzer (FPD, 30m)
500-C2-095 - Companion 2 Portable Sulfur Compounds GC Analyzer (FPD, 30m)

Sulfur Compounds

Companion 2 Portable GC

Peak	Component	Area
1	Hydrogen Sulfide	1787.9
2	Carbonyl Sulfide	2639.5
3	Methyl Mercaptan	3484.1
4	Ethyl Mercaptan	284.6
5	Carbon Disulfide	8370.5
6	Dimethyl Sulfide	8031.7
7	2-Propyl Mercaptan	5168.1
8	Allyl Mercaptan	7467.7
9	1-Propyl Mercaptan	7080.3
10	Ethyl Sulfide	3838.2
11	Butyl Mercaptan	1367.3
12	Dimethyl Disulfide	8883.5
13	Allyl Sulfide	8360.7
14	Propyl Sulfide	979.9
15	Butyl Sulfide	874.1



Petrochemical

Transformer Oil Gas Analysis - TOGA

DPS Instruments, Inc.

www.dps-instruments.com

The DPS TOGA GC Systems are designed to analyze oil from electrical insulation materials that may have decomposed under thermal, or electrical stresses. The gaseous decomposition products indicate the type of fault inside the transformer. The DPS TOGA GC Systems separate all 11 components in one injection; Hydrogen, Oxygen, Nitrogen, Methane, Carbon Monoxide, Ethane, Carbon Dioxide, Ethylene, Propane, Acetylene, and Propylene. All compounds are detected with the sensitive and universal Helium Ionization Detector (HID). A Flame Ionization Detector (FID) and Methanizer can be added for even lower detection limits of the hydrocarbons, CO & CO2. Our innovative 2 column and valve configuration simplifies this analysis and follows ASTM 3612C for gas analysis using headspace injection. The headspace sample can be injected using a multi-vial autosampler, or a single sample headspace accessory can be built into our Series 600 Lab GC, or the Portable Companion 2 for analyses in the field. The fast heating and rapid cooling column oven in every DPS GC assures rapid sample turnaround. The fully integrated TOGA GC Analyzer Systems are small and lightweight and all DPS systems are modular for expandability, upgrades, and easy service.

Available Configurations Include:

600-C-078 - Series 600 TOGA GC Analyzer (HID, Headspace Concentrator, 2 Columns)
600-C-082 - Series 600 TOGA GC Analyzer (HID, FID/Methanizer, Headspace Concentrator, etc.)

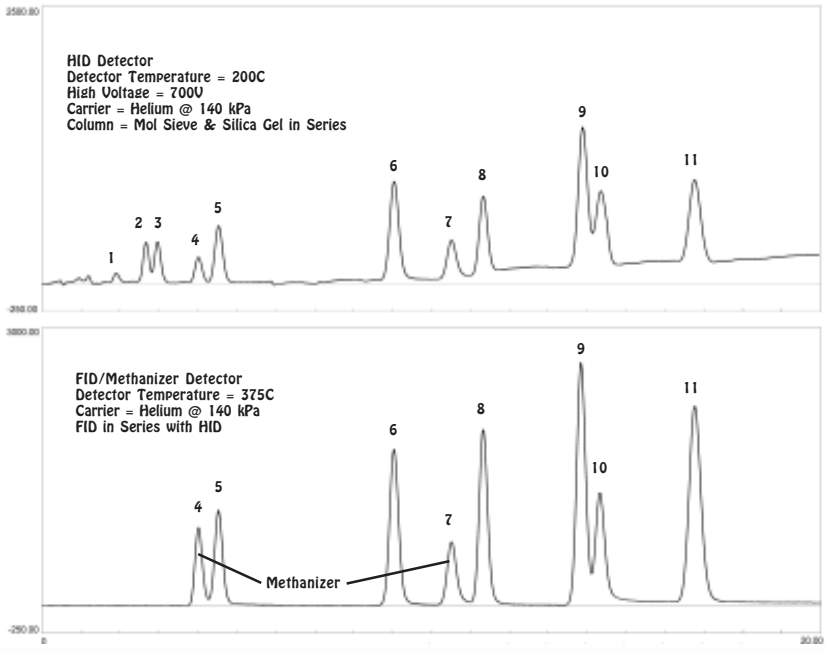
500-C2-078 - Companion 2 Portable TOGA GC Analyzer (HID, Headspace Concentrator, 2 Columns)
500-C2-082 - Companion 2 Portable TOGA GC Analyzer (HID, FID/Methanizer, Headspace Concentrator, etc.)

TOGA - Gas Analysis

Series 600 GC

Companion 2 Portable GC
(with Headspace Concentrator)

Peak	Component
1	Hydrogen
2	Oxygen
3	Nitrogen
4	CO
5	Methane
6	Ethane
7	CO2
8	Ethylene
9	Propane
10	Acetylene
11	Propylene



3/2022
Specifications may change without notice.

Petrochemical
Bio-Diesel

DPS Instruments, Inc.

www.dps-instruments.com

Bio-diesel is a renewable fuel used as a substitute for petroleum diesel fuel. Biodegradable and nontoxic, bio-diesel is made from soy oil, vegetable oil, recycled cooking oil, or animal fat. Bio-diesel made from vegetable oils and animal fat perform like petroleum diesel, but are much cleaner burning with reduced emissions. A high content of free and total glycerin lead to buildup and poor engine performance. Consequently, the glycerin content is one indicator of the quality of the bio-diesel fuel. For your convenience, DPS has configured the Bio-diesel GC Analyzers to help you define the free and total glycerin content using our standard cool on-column injector, guard column, analytical column, and our sensitive FID detector. The fast heating and rapid cooling column oven in every DPS GC vastly increases your sample throughput. The fully integrated Bio-diesel GC Analyzer Systems are small, lightweight, and rugged to go where ever you need them. All DPS systems are modular for expandability, upgrades, and easy service.

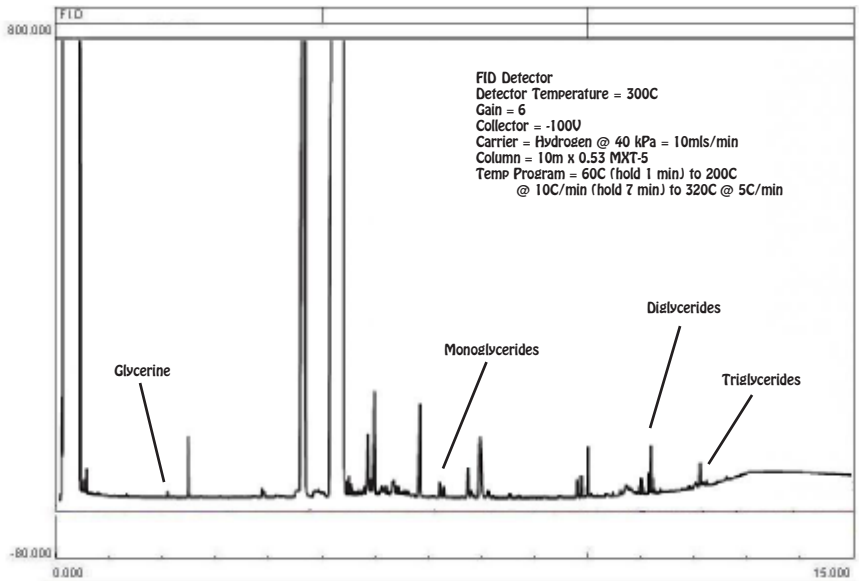
Series 600 GC

Available Configurations Include:

600-C-031 – Series 600 Bio-diesel GC Analyzer (FID, 10m)
500-C-031 – Companion 1 Portable Bio-diesel GC Analyzer (FID, 10m)

Companion 1 Portable GC

Glycerine in Bio-Diesel



Petrochemical

BTU - Heating Value

Instruments, Inc.

www.dps-instruments.com

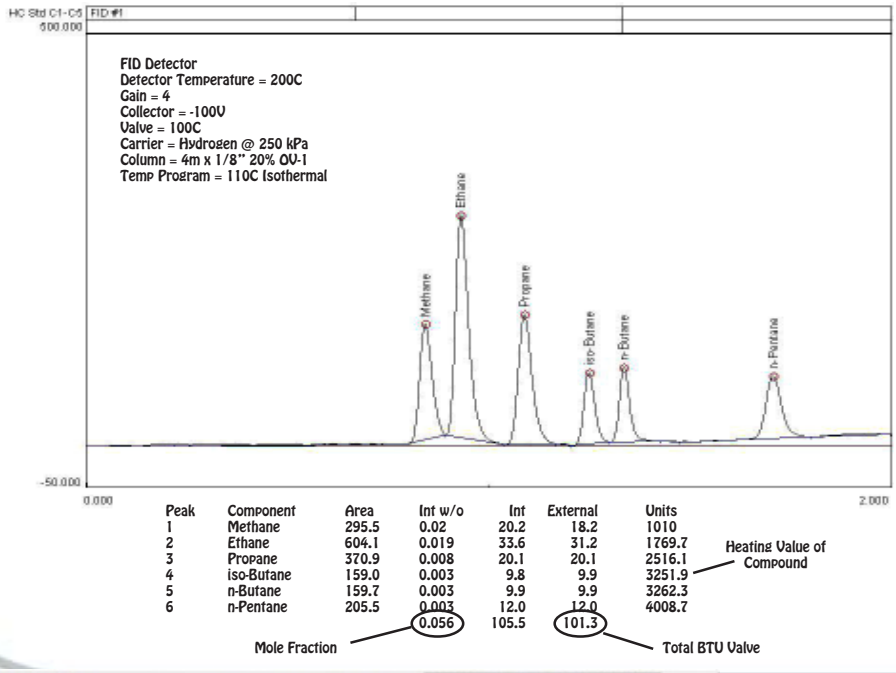
Every day millions of cubic feet of natural gas flow through pipelines around the world. The heating value, measured as BTU, determines the cost and ultimate value of the natural gas. The natural gas may either be in a gas or liquid phase, where larger hydrocarbons always have a higher heating value. The rugged and reliable Series 600 laboratory and Companion portable versions of the DPS BTU GC Systems automatically sample and analyze the natural gases coming from these pipelines. The analysis of C1 - C5 hydrocarbons by our sensitive FID detector takes less than 2 minutes, and we don't program the column oven, so that samples can be run one after another quickly. The BTU value is automatically calculated and reported after each analysis. The GC Systems can also be configured with a second detector to measure whole gas components and a methanizer for Carbon Dioxide. The fully integrated BTU GC Systems are small and lightweight and all DPS systems are modular for expandability, upgrades, and easy service.

Series 600 GC

Available Configurations Include:

600-C-096 - BTU GC Analyzer (FID, Valve, 2m)
500-C-096 - Companion 1 Portable BTU GC Analyzer (FID, Valve, 2m)

Low Level Natural Gas Standard



Peak	Component	Area	Int w/o	Int	External	Units
1	Methane	295.5	0.02	20.2	18.2	1010
2	Ethane	604.1	0.019	33.6	31.2	1769.7
3	Propane	370.9	0.008	20.1	20.1	2516.1
4	iso-Butane	159.0	0.003	9.8	9.9	3251.9
5	n-Butane	159.7	0.003	9.9	9.9	3262.3
6	n-Pentane	205.5	0.003	12.0	12.0	4008.7
			0.056	105.5	101.3	

Heating Value of Compound

Mole Fraction

Total BTU Valve

Companion 1 Portable GC

11/2015
Specifications may change without notice.

Petrochemical

Freon Gases

DPS Instruments, Inc.

www.dps-instruments.com

For over 80 years, chlorofluorocarbons have been the compounds of choice to use as refrigerants, which are compounds used in heat cycles that undergo a phase change from a gas to a liquid and back. Until concerns about depletion of the ozone layer, global warming, and the rise in cases of skin cancer. In the 1980's, the most widely used refrigerants were the chlorofluoromethanes, R-12 and R-22, with R-12 being more common in automotive air conditioning and small refrigerators, and R-22 being used for residential and light commercial air conditioning, refrigerators, and freezers. More recently, less ozone destructive compounds like Freon 134, which is a fluorocarbon only, have been developed to replace the ozone depleting chlorofluorocarbons. The DPS Freon Gases GC Systems are designed with safety in mind to check the purity of the Freon, monitor workplace conditions, detect leaking refrigerants, or monitor concentrations in the atmosphere. Let the latest designed high resolution column and the sensitive FID detector do the hard work for you. We have also added a Gas Sampling Valve to automate your sampling and analysis. The fast heating and rapid cooling column oven in every DPS GC vastly increases your sample throughput. The fully integrated Freon Gases GC Systems are small and lightweight and all DPS systems are modular for expandability, upgrades, and easy service.

Available Configurations Include:

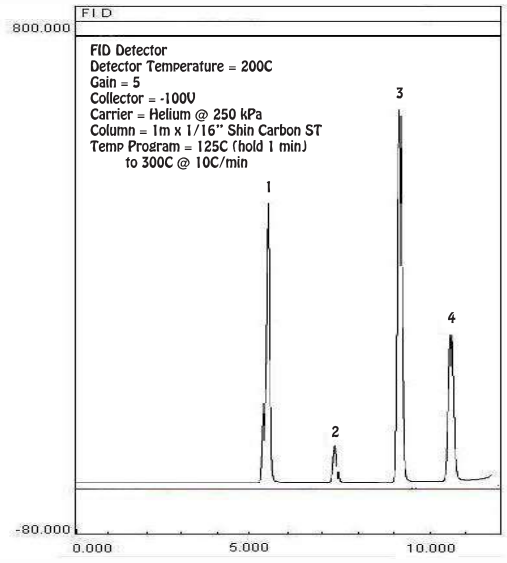
600-C-090 - Series 600 Freon Gases GC Analyzer (FID, Valve, 1m)
500-C-090 - Companion 1 Portable Freon Gases GC Analyzer (FID, Valve, 1m)

Series 600 GC

Companion 1 Portable GC

Freon Gases

Peak	Component	Area
1	Freon 134	2911.8
2	Freon 12	639.5
3	Freon 113	306.7
4	Freon 114	1684.6



11/2015
Specifications may change without notice.

Petrochemical
Hydrocarbon Fuels

DPS Instruments, Inc.

www.dps-instruments.com

From Aviation Fuel, to Gasoline, to Kerosene, to Crude oil and everything in between, Gas Chromatography has been the separation instrument of choice for over 50 years. There are literally hundreds of GC methods for liquid petroleum hydrocarbons analysis from the Petroleum, Chemical, and Environmental industries. Although each method is distinct, most rely on latest designed high resolution capillary columns and the sensitive FID detector. Let our experts help you determine the exact DPS Hydrocarbon Fuels GC System components for your specific requirements with either our Series 600 Lab GC, or the Portable Companion. With the Lab GC we have added a Split/Splitless injector to perform the dilutions for you. The fast heating and rapid cooling column oven in every DPS GC vastly increases your sample throughput. The fully integrated Hydrocarbon Fuels GC Systems are small and lightweight and all DPS systems are modular for expandability, upgrades, and easy service.

Available Configurations Include:

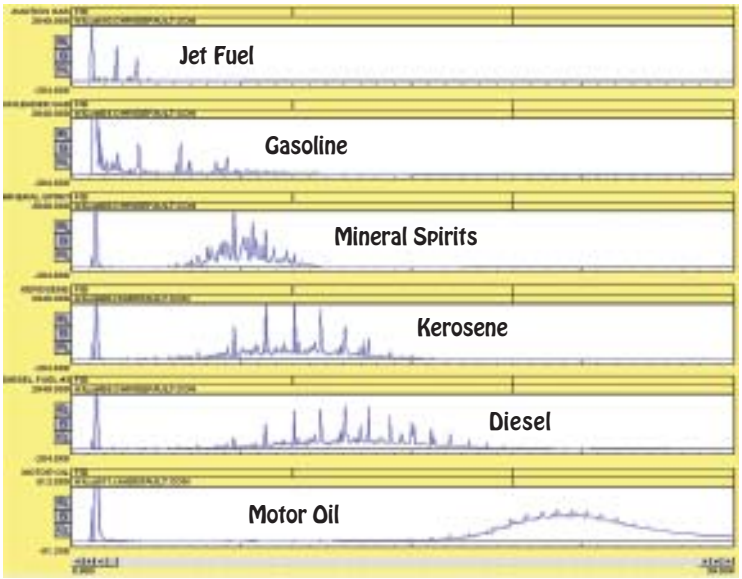
600-C-092 - Series 600 Hydrocarbon Fuels GC Analyzer (FID, S/S, 30m)
500-C-092 - Companion 1 Portable Hydrocarbon Fuels GC Analyzer (FID, 30m)

Series 600 GC

Companion 1 Portable GC

Hydrocarbon Fuels

FID Detector
Detector Temperature = 300C
Gain = 4
Collector = -100V
Carrier = Helium @ 40 kPa = 10mls/min
Column = 30m x 0.53 MXT-5
Temperature Program = 60C (hold 2 min)
to 250C @ 8C/min



11/2015
Specifications may change without notice.

Petrochemical
Hydrocarbon Gases

DPS Instruments, Inc.

www.dps-instruments.com

In Natural Gas and other hydrocarbon products, the separations of the light hydrocarbon gases in the C1 - C4 range have always been a challenge. The compound separations are economically critical, because the compounds determine the BTU value, which dictates the value of the gas product. The isomers of the C2's and C4's have, in the past, been particularly difficult to separate. GC Systems have been configured with multiple columns and detectors and complex valve systems to attempt to solve the analysis problem. The development of capillary columns for light hydrocarbon separations has helped tremendously. The DPS Hydrocarbon Gases GC System is configured with the latest designed high resolution capillary column and the sensitive FID detector to quickly detect these compounds. In the Series 600 we have added a Split/Splitless injector to dilute concentrated gas samples for you. The fast heating and rapid cooling column oven in every DPS GC assures rapid sample turnaround. We have added a gas sampling valve to increase your throughput by automating the sampling and then injecting samples for you. The fully integrated Hydrocarbon Gases GC Systems are small and lightweight and all DPS systems are modular for expandability, upgrades, and easy service.

Series 600 GC

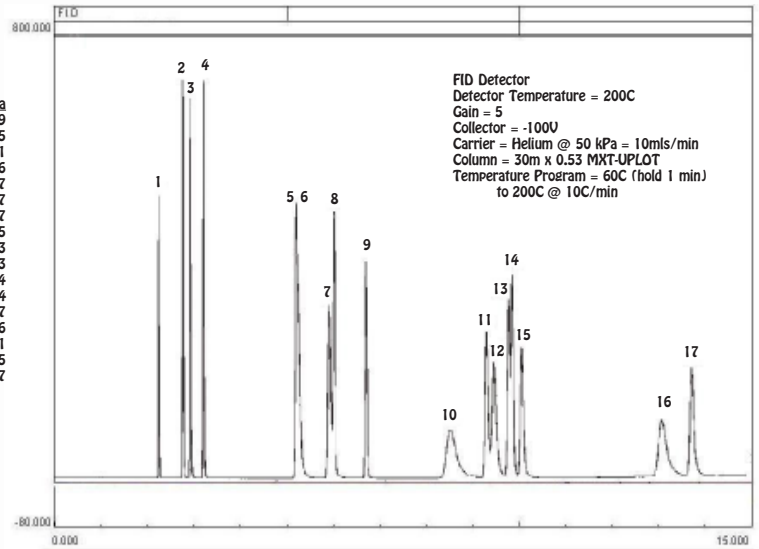
Available Configurations Include:

600-C-091 - Series 600 Hydrocarbon Gases GC Analyzer (FID, S/S, Valve, 30m)
500-C-091 - Companion 1 Portable Hydrocarbon Gases GC Analyzer (FID, Valve, 30m)

Companion 1 Portable GC

Hydrocarbon Gases

Peak	Component	Area
1	Methane	1487.9
2	Ethylene	2639.5
3	Ethene	2484.1
4	Acetylene	2684.6
5	Propane	1204.7
6	Propylene	1192.7
7	Cyclopropane	1204.7
8	Propadiene	1070.5
9	Propyne	980.3
10	iso-Butane	1288.3
11	n-Butane	767.4
12	1-Butene	583.4
13	cis-2-Butene	660.7
14	trans-2-Butene	750.6
15	1,3,-Butadiene	604.1
16	iso-Pentane	960.5
17	n-Pentane	556.7



Petrochemical

Methods 25 & 25A - C1-C6 Hydrocarbons

DPS Instruments. Inc.

www.dps-instruments.com

Methane is a gas that is naturally formed from the decomposition of biological materials and also produced in many industrial processes. Although Methane is not usually considered an environmental pollutant, the non-Methane composition of gas samples around cities, in industrial areas, and at waste sites is of greater concern. DPS has engineered the Method 25 & 25A GC System, utilizing a Backflush plumbing configuration, to analyze these compounds. Method 25 is for methane and non-methane hydrocarbons, while Method 25A is for total hydrocarbons. The GC System is exactly the same, but not only limited to these analyses, it can also separate the individual C1 - C6 hydrocarbons to further identify the gas sample. Using the rugged and reliable Series 600 Lab GC, or Companion 1 Portable GC, the DPS Method 25 & 25A GC System automatically samples and analyzes the C1 - C6 hydrocarbons using our sensitive FID detector. The fully integrated Method 25 & 25 A GC System is small and lightweight and all DPS systems are modular for expandability, upgrades, and easy service.

Series 600 GC

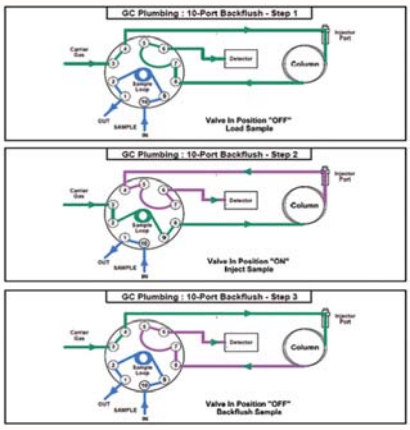
Available Configurations Include:

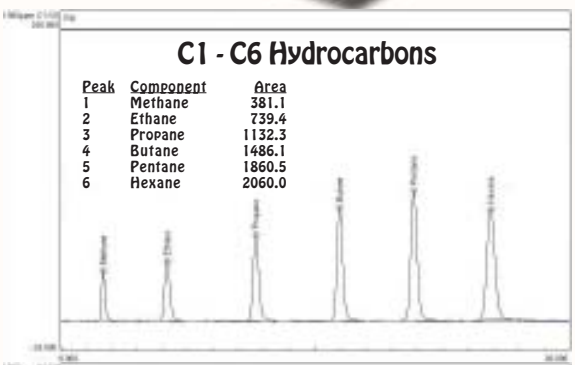
600-C-094 - Series 600 Method 25 & 25A GC Analyzer (FID, Valve, 1m Column)
500-C-094 - Companion 1 Portable Method 25 & 25A GC Analyzer (FID, Valve, 1m Column)

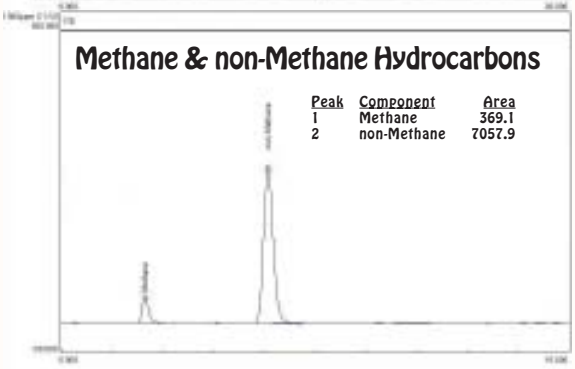
Companion1 Portable GC

Method 25 Hydrocarbons

FID Detector
Detector Temperature = 300C
Gain = 4
Valve = 150C
Collector = -100V
Carrier = Helium @ 120 kPa = 10mls/min
Column = 2m x 1/8" Silica Gel
Temperature Program = 80C (hold 2 min) to 240C @ 15C/min







11/2015
Specifications may change without notice.

Petrochemical

Mine Safety 12

DPS Instruments, Inc.

www.dps-instruments.com

In every mine there is a chance that the Gases naturally occurring might build up to a high enough concentration to become explosive. The monitoring of these gas concentrations, therefore becomes a concern to maintain the safety of the mine workers. The key compounds of interest are Hydrocarbons in the C1 - C2 range and Carbon Monoxide and Carbon Dioxide. These light hydrocarbon gases have always been a challenge to separate. The development of capillary columns for light hydrocarbon separations has helped tremendously. The DPS Mine Safety GC System is configured with these latest designed high resolution capillary column and the sensitive FID, to quickly detect these potentially explosive compounds in less than 2 minutes. We have added a Vacuum Pump and Gas Sample Valve to fully automate the sample analysis. The fast heating and rapid cooling column oven in every DPS GC assures rapid sample turnaround. The fully integrated Mine Safety GC System is small and lightweight and all DPS systems are modular for expandability, upgrades, and easy service.

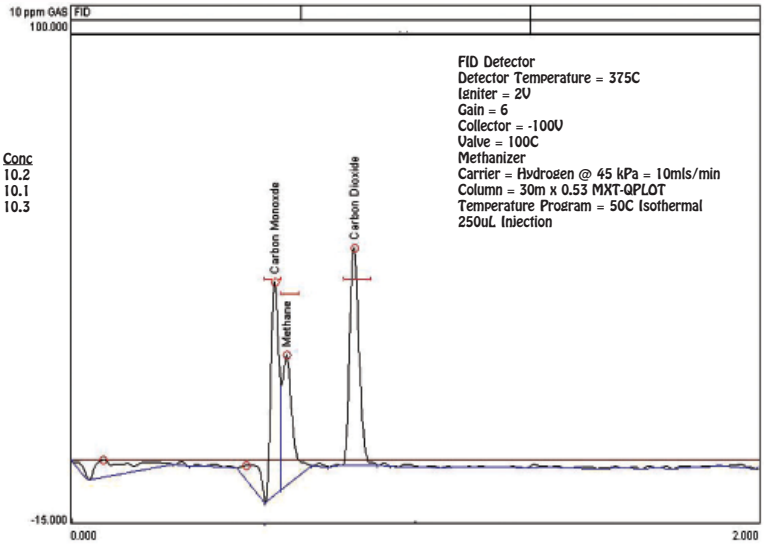
Available Configurations Include:

500-C2-091 - Companion 1 Portable Mine Safety GC Analyzer (FID, 30m)
Includes: 10-port Gas Sampling Valve, Valve Oven, Vacuum Pump, Methanizer, and "Ultra Quiet" Air Compressor

Companion 1 Portable GC

Mine Safety Gases

Peak	Component	Area	Conc
1	Carbon Monoxide	81.4	10.2
2	Methane	61.2	10.1
3	Carbon Dioxide	95.7	10.3



11/2015
Specifications may change without notice.

Petrochemical
Mud-Logging

Instruments. Inc.

www.dps-instruments.com

The process of Mud-logging involves collecting, analyzing and recording the meaningful solids, fluids, and gasses brought to the surface by the drilling fluid (mud). For the gas analysis portion of the mud-logging process, the rugged and reliable DPS Mud-logging GC System automatically samples and analyzes the gases coming out of the mud for methane and heavier hydrocarbons using a sensitive FID detector. The entire cycle time for speciation of C1 - C5 hydrocarbons is less than 2 minutes and the BTU value is automatically calculated. A 2nd FID detector is added to determine total hydrocarbons at the same time. Using a built-in air compressor, the entire system runs off one tank of hydrogen. Adding a methanizer to the FID to analyze CO2 is especially helpful for monitoring a well once you have hit pay dirt! The fully integrated Mud-logging GC Systems are small and lightweight and all DPS systems are modular for expandability, upgrades, and easy service.

Series 600 GC

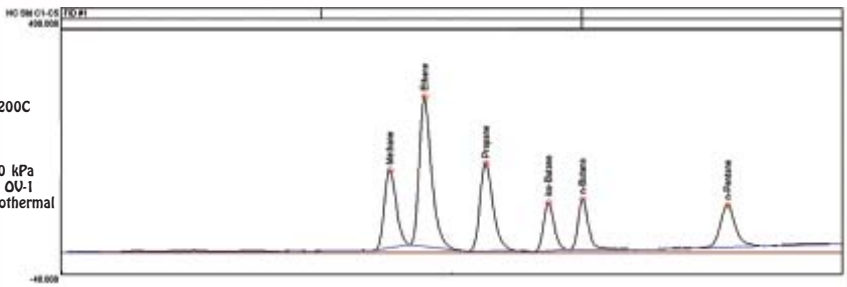
Available Configurations Include:

600-C-093 - Series 600 Mud Logging GC Analyzer (FID, FID, Valve, 2m)
500-C2-093 - Companion 2 Portable Mud Logging GC Analyzer (FID, FID, Valve, 2m)

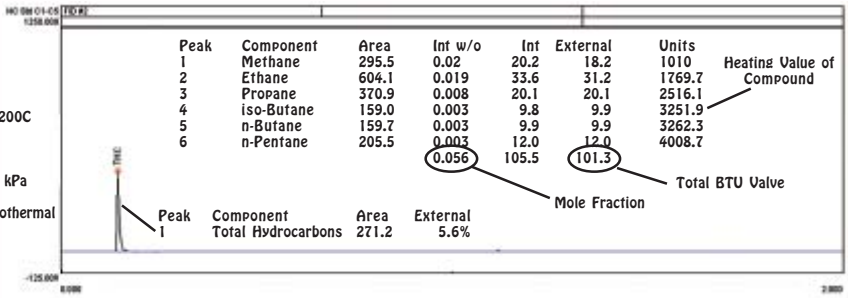
Companion 2 Portable GC

Low Level Natural Gas Standard

FID Detector #1
Detector Temperature = 200C
Gain = 4
Collector = -100V
Valve = 100C
Carrier = Hydrogen @ 250 kPa
Column = 4m x 1/8" 20% OV-1
Temp Program = 110C Isothermal



FID Detector #2
Detector Temperature = 200C
Gain = 3
Collector = -100V
Valve = 100C
Carrier = Hydrogen @ 50 kPa
Column = None
Temp Program = 110C Isothermal



Peak	Component	Area	Int w/o	Int	External	Units	
1	Methane	295.5	0.02	20.2	18.2	1010	Heating Value of Compound
2	Ethane	604.1	0.019	33.6	31.2	1769.7	
3	Propane	370.9	0.008	20.1	20.1	2516.1	
4	iso-Butane	159.0	0.003	9.8	9.9	3251.9	
5	n-Butane	159.7	0.003	9.9	9.9	3262.3	
6	n-Pentane	205.5	0.003	12.0	12.0	4008.7	
			0.056	105.5	101.3		Total BTU Valve

Mole Fraction

Peak	Component	Area	External
1	Total Hydrocarbons	271.2	5.6%

11/2015
Specifications may change without notice.

Petrochemical

Natural Gas - Heating Valve & Permanent Gases

DPS Instruments. Inc.

www.dps-instruments.com

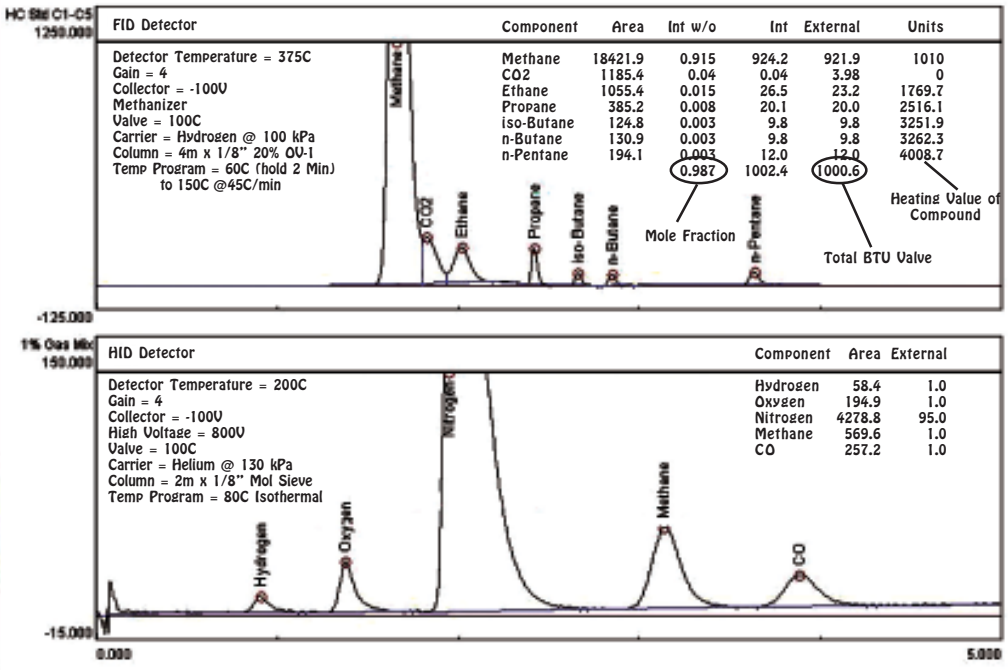
Every day millions of cubic feet of natural gas flow through pipelines around the world. The heating value, sometimes measured as BTU, determines the cost and ultimate value of the natural gas. The natural gas may either be in a gas or liquid phase. Larger hydrocarbons always have a higher heating value. Additionally, it is important to know the contribution of the Permanent Gases (H2, O2, N2, CO & CO2) in the sample. DPS has engineered a GC system to analyze all of these compounds simultaneously using the reliable Series 600 Lab GC, or the rugged Companion 2 Portable GC. The DPS Natural Gas GC Systems automatically sample and analyze the natural gases coming from these pipelines. The analysis of C1 - C5 hydrocarbons with our sensitive FID detector, Permanent Gases with the universal HID detector, and a Methanizer for the Carbon Dioxide. The Heating Value is automatically calculated and reported after each analysis. The fully integrated Natural Gas GC Systems are small and lightweight and all DPS systems are modular for expandability, upgrades, and easy service.

Available Configurations Include:

600-C-135 - Series 600 Natural Gas GC Analyzer (HID, FID/Methanizer, Valve, 2 Columns)
500-C2-135 - Companion 2 Natural Gas GC Analyzer (HID, FID/Methanizer, Valve, 2 Columns)

Series 600 GC

High Level Natural Gas Standard



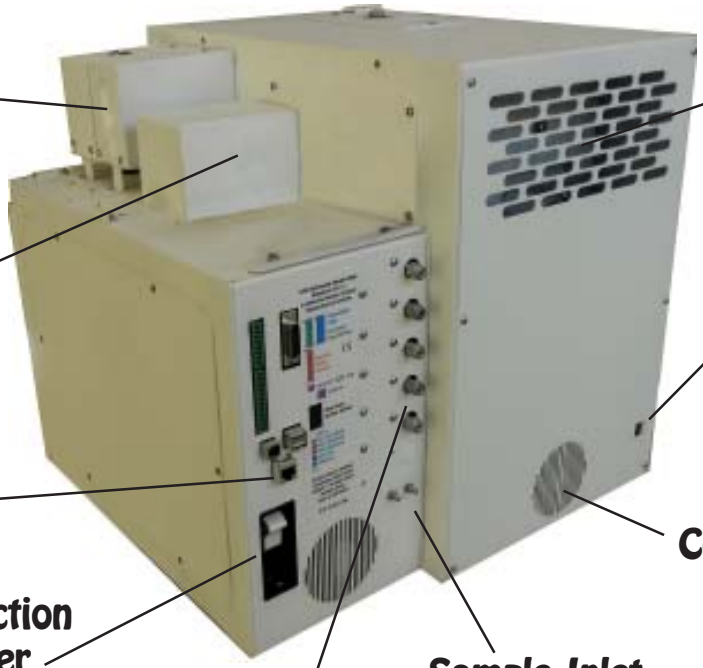
Companion 2 Portable GC

2/2020
Specifications may change without notice.

DPS Natural Gas Layouts

Companion 2 GC

Series 600 GC



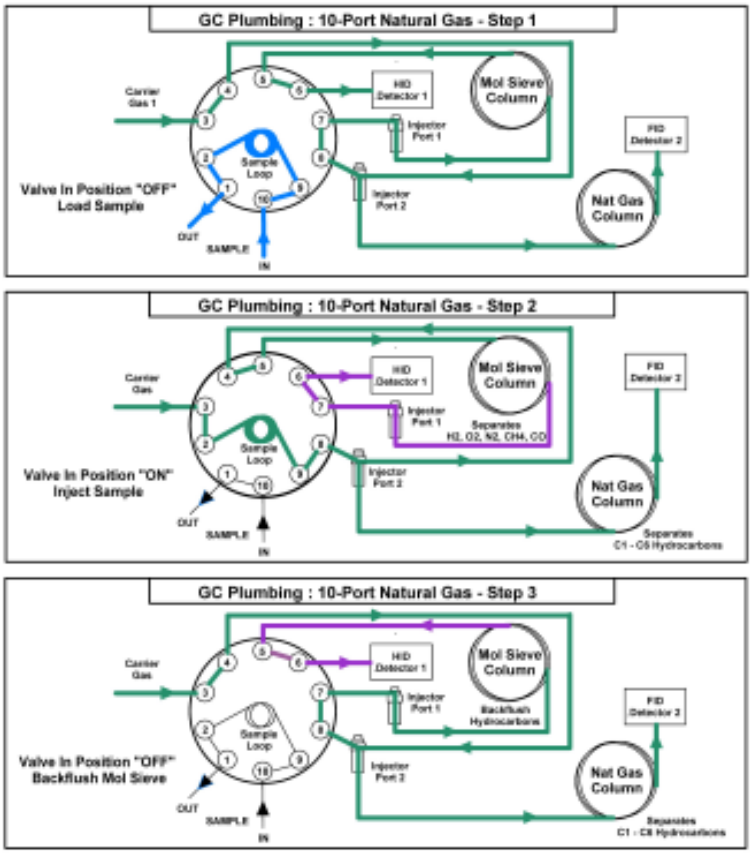
Plumbing Diagram

Load: In Step 1 the sample is loaded onto the fixed volume sample loop with the valve in the OFF position. The sample can be loaded either under positive pressure, or the with the aid of a built-in Vacuum Pump. The same carrier gas flows through each column, however a sample, or standard can always be manually injected into either Injector.

Inject: The Sample Valve is rotated to the ON position and the carrier gases sweep the components from the Sample Loop and splits it between the the analytical columns. The permanent gases are separated in a molecular sieve column going to the HID detector. For the C1-C5 hydrocarbon separation we use a 2m packed column which goes to the FID detector.

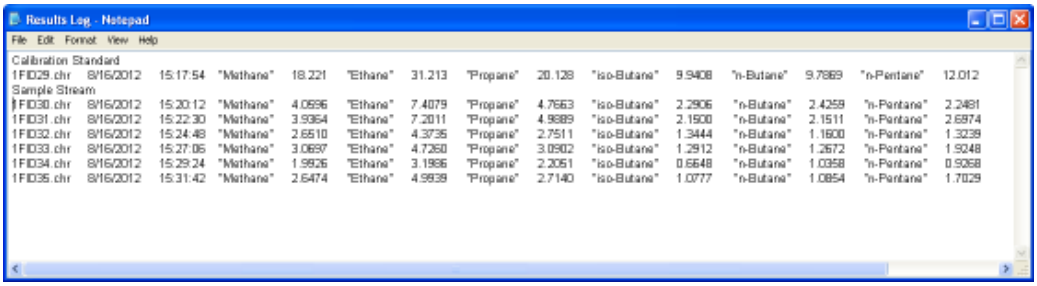
Backflush: The Sample Valve is rotated back to the OFF position and the heavier compounds are swept from the molecular sieve column to keep it clean.

Fast Cycle Times: For the fastest cycle times the Column Oven temperature is held constant, so that one sample can be run iommediately after another. We use a Pressure Program Ramp to push the heavier compounds through the column faster.



Natural Gas Plumbing Diagram

Results Log



Results Log - Notepad

File Edit Format View Help

Calibration Standard

1FID29.chr	8/16/2012	15:17:54	"Methane"	18.221	"Ethane"	31.213	"Propane"	20.128	"iso-Butane"	9.9408	"n-Butane"	9.7869	"n-Pentane"	12.012

Sample Stream

1FID30.chr	8/16/2012	15:20:12	"Methane"	4.0696	"Ethane"	7.4079	"Propane"	4.7663	"iso-Butane"	2.2906	"n-Butane"	2.4259	"n-Pentane"	2.2481
1FID31.chr	8/16/2012	15:22:30	"Methane"	3.9364	"Ethane"	7.2011	"Propane"	4.9889	"iso-Butane"	2.1500	"n-Butane"	2.1511	"n-Pentane"	2.6974
1FID32.chr	8/16/2012	15:24:48	"Methane"	2.6510	"Ethane"	4.3735	"Propane"	2.7511	"iso-Butane"	1.3444	"n-Butane"	1.1600	"n-Pentane"	1.3239
1FID33.chr	8/16/2012	15:27:06	"Methane"	3.0697	"Ethane"	4.7260	"Propane"	3.0902	"iso-Butane"	1.2912	"n-Butane"	1.2672	"n-Pentane"	1.9248
1FID34.chr	8/16/2012	15:29:24	"Methane"	1.9926	"Ethane"	3.1986	"Propane"	2.2051	"iso-Butane"	0.6648	"n-Butane"	1.0358	"n-Pentane"	0.9368
1FID35.chr	8/16/2012	15:31:42	"Methane"	2.6474	"Ethane"	4.9939	"Propane"	2.7140	"iso-Butane"	1.0777	"n-Butane"	1.0854	"n-Pentane"	1.7029

The sample results can be stored and reported in various ways. One convenient method of storing a vast amount of sample data is in a Results Log. A separate Results Log can be generated for each detector. In the example above the first analysis is a low level calibration standard. The subsequent analyses are from a sample stream coming from the well. The BTU value is reported next to each compound. The sample results can be stored on the hard drive of the computer inside the GC, or on an external computer via an ethernet connection.

GC Control Software

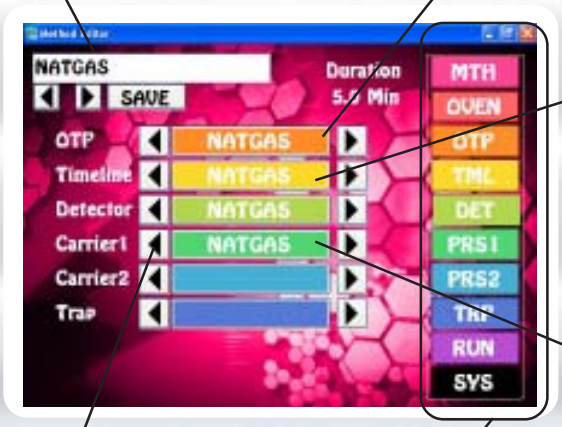
Easy to learn and master using a Graphical User Interface (GUI) and Color Touch Screen.

Editors let you customize the files associated with the GC Method.

Oven Temp Program Editor

Timeline Editor

Method Name



File Selection Arrows

Navigation Buttons to Quickly jump from one screen to another. Most pages are one button away!

Carrier Pressure 1 Editor

Keyboard to Enter Filenames

Number Pad for entering Values

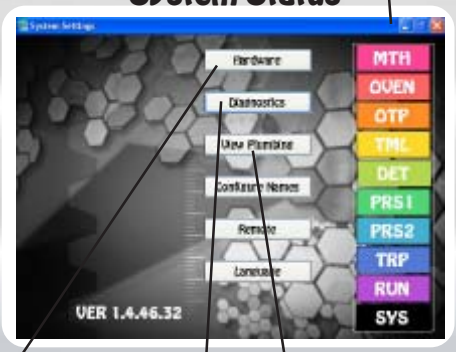
GC Status pages display the parameters in the method, both graphically and as text and values.

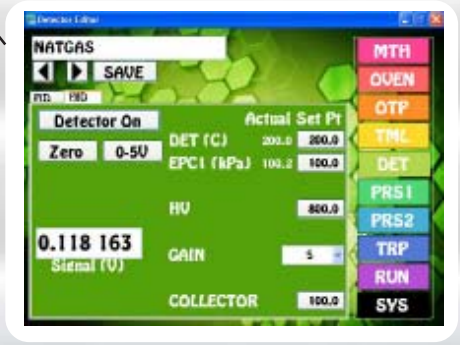
Oven Status

Method Editor

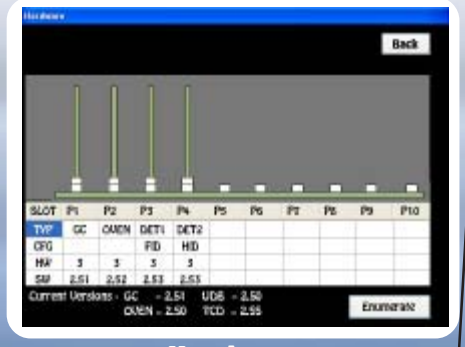
FID Detector Status

System Status





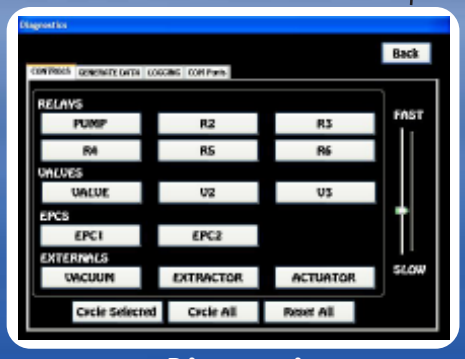
HID Detector Status



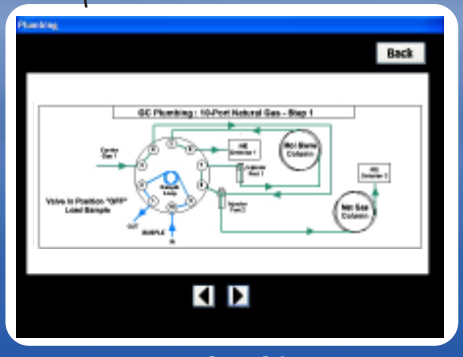
Hardware

System status pages display the health and viability of the GC instrument.

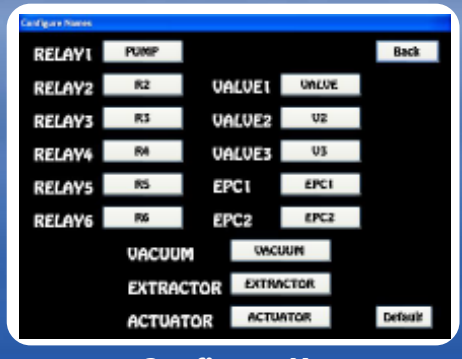
Run Status



Diagnostics



Plumbing



Configure Names

Specifications may change without notice.
01/2016

Natural Gas GC Specifications:

Electronics Module:
- Enter and store GC Methods via Color Touch Screen
- Actual and set-point display of all GC parameters
- Safety Limits on all user entered parameters
- Oven Temperature Programs (OTP) with Multiple Ramps
- Pressure Programs for Carrier Gases with Multiple Ramps
- Timeline for sequencing Relays and Valve
- Detector Control of all Parameters on one page
- Electronic Pressure Controllers (EPC's):
  Atmospheric Pressure & Temperature Compensation
  EPC Pressure Control with 0.1 kPa set-point resolution
- Plug and Play GC Control, Oven, and Detector Board
- Microprocessor Controlled
- Proprietary Digital Signal Processing
- Digital Signal Outputs for each Detector
- Universal voltage input (85 – 240 Vac) with line filter and breaker.

Detector:
HID – Helium Ionization Detector (10 ppm detection limit, dependent on sample loop size)
FID – Flameionization Detector (1ng detection limit, dependent on sample loop size)

- 400 °C Temperature Limit with 0.1 °C set-point resolution
- 24-bit Digital Outputs for the detector via USB
- EPC Pressure Control with 0.1 kPa set-point resolution

Columns:
1m Molecular Sieve, 2m 20% Ov-1

Results:
Automatically calibration corrected and reported

Series 600 Oven Module:
- Ambient to 400°C Column Oven
- Up to 100 °C per/min Oven Ramp
- Fast Cooldown 300 °C to 50 °C in 3.5 min
- 1000 watt total Heater Elements
- Temperature Ramps with 0.1 °C set-point resolution
- 23 x 23 x 20 cm area for Glass, SS, or Capillary Columns

Companion 2 Oven Module:
- Ambient to 325 °C Column Oven
- Up to 80 °C per/min Oven Ramp
- Fast Cooldown 300 °C to 50 °C < 4 min
- 200 watt Heater Element
- Temperature Ramps with 0.1 °C set-point resolution
- 12.5 x 10.5 x 12.5 cm area for Packed, or Capillary Columns
- 7 amps at 48 Vdc total power consumption

Built-In Accessories:
- Sample Valve - Electronically Actuated
- Heated Valve Oven
- Vacuum Pump
- Air Compressor for FID's
- Calibration Gas & Stream Selection Solenoid

Injector:
- Heated On-column Injectors
- Multiple Pressure Ramps with 0.1 kPa set-point resolution

Data Communications:
- Bi-directional communication with popular Data System

Network Connectivity:
- Enterprise Compatible Network GC running Windows XPe
- Ethernet Connection using Windows Network Protocol
- On Board ETX Computer for GC Control and Data Acquisition
- Remote Control of GC and Data Acquisition over LAN

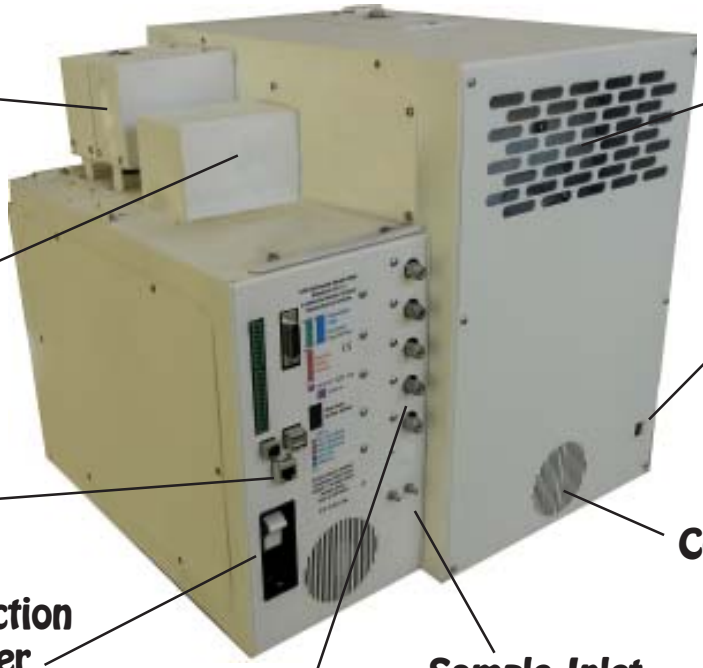
Lab Quality Analyses in the Field,
"It Goes with you Anywhere!"

DPS Instruments, Inc.

DPS Mudlogging Layouts

Companion 2 GC

Series 600 GC

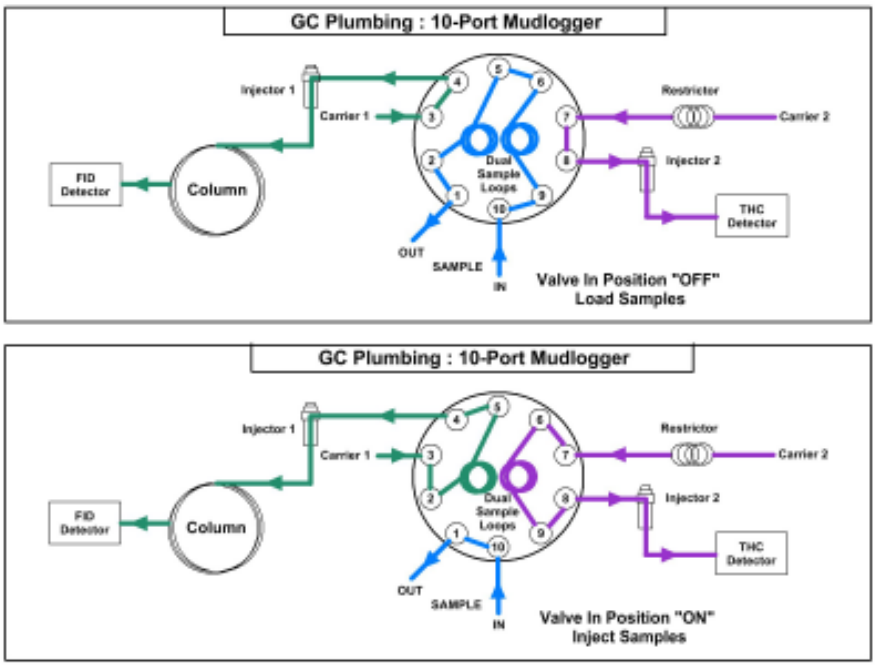


Plumbing Diagram

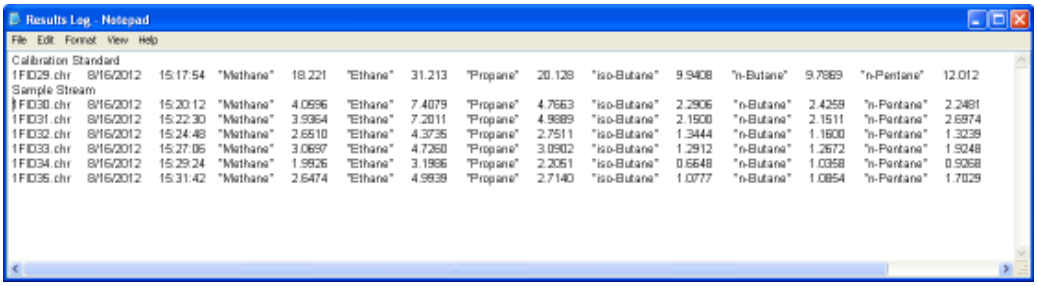
Load: The sample is simultaneously loaded onto both sample loops, either under positive pressure, or the with the aid of a built-in Vacuum Pump. Independent carrier gases connect to each injector. A sample, or standard can always be manually injected into either Injector.

Inject: The Sample Valve is rotated to the ON position and the carrier gases sweep the components from the Sample Loop onto the analytical column and to the THC detector. For the C1-C5 hydrocarbon separation we use a 2m packed column. For the fastest cycle times the Column Oven temperature is held constant, however we use a Pressure Program Ramp to push the heavier compounds through the column faster. For the Total Hydrocarbon analysis there is no column connected to the 2nd injector and all of the hydrocarbons pass to the detector together generating a THC peak, that can be quantitated and reported.

Dual Sample Loop Plumbing Diagram



Results Log



Results Log - Notepad

File Edit Format View Help

Calibration Standard													
1FID29.chr	8/16/2012	15:17:54	"Methane"	18.221	"Ethane"	31.213	"Propane"	20.128	"iso-Butane"	9.9408	"n-Butane"	9.7869	"n-Pentane"	12.012
Sample Stream													
1FID30.chr	8/16/2012	15:20:12	"Methane"	4.0696	"Ethane"	7.4079	"Propane"	4.7663	"iso-Butane"	2.2906	"n-Butane"	2.4258	"n-Pentane"	2.2481
1FID31.chr	8/16/2012	15:22:30	"Methane"	3.9364	"Ethane"	7.2011	"Propane"	4.9889	"iso-Butane"	2.1500	"n-Butane"	2.1511	"n-Pentane"	2.6974
1FID32.chr	8/16/2012	15:24:48	"Methane"	2.6510	"Ethane"	4.3735	"Propane"	2.7511	"iso-Butane"	1.3444	"n-Butane"	1.1600	"n-Pentane"	1.3239
1FID33.chr	8/16/2012	15:27:06	"Methane"	3.0697	"Ethane"	4.7260	"Propane"	3.0902	"iso-Butane"	1.2912	"n-Butane"	1.2672	"n-Pentane"	1.9248
1FID34.chr	8/16/2012	15:29:24	"Methane"	1.9926	"Ethane"	3.1986	"Propane"	2.2051	"iso-Butane"	0.6648	"n-Butane"	1.0358	"n-Pentane"	0.9368
1FID35.chr	8/16/2012	15:31:42	"Methane"	2.6474	"Ethane"	4.9939	"Propane"	2.7140	"iso-Butane"	1.0777	"n-Butane"	1.0854	"n-Pentane"	1.7029

The sample results can be stored and reported in various ways. One convenient method of storing a vast amount of sample data is in a Results Log. A separate Results Log can be generated for each detector. In the example above the first analysis is a low level calibration standard. The subsequent analyses are from a sample stream coming from the well. The BTU value is reported next to each compound. The sample results can be stored on the hard drive of the computer inside the GC, or on an external computer via an ethernet connection.

GC Control Software

Easy to learn and master using a Graphical User Interface (GUI) and Color Touch Screen.

Editors let you customize the files associated with the GC Method.

Oven Temp Program Editor

Timeline Editor

Method Name

File Selection Arrows

Carrier Pressure 1 Editor

Navigation Buttons to Quickly jump from one screen to another. Most pages are one button away!

Carrier Pressure 2 Editor

Keyboard to Enter Filenames

Number Pad for entering Values

GC Status pages display the parameters in the method, both graphically and as text and values.

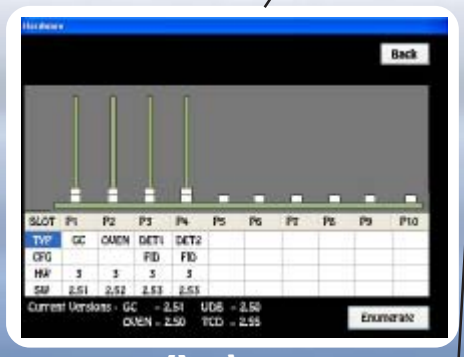
Oven Status

Method Editor

FID1 Detector Status

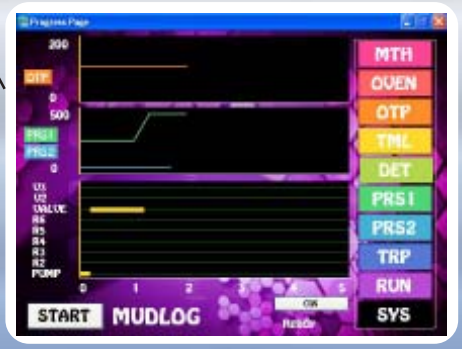
System Status

FID2 Detector Status

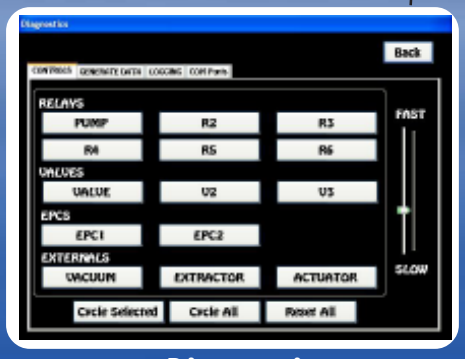


Hardware

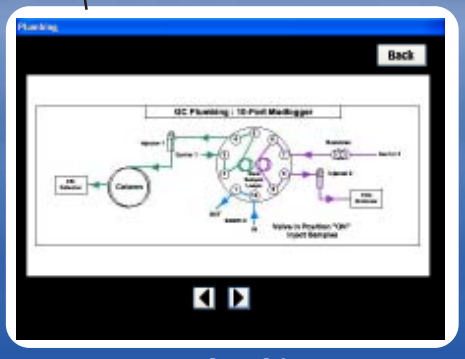
System status pages display the health and viability of the GC instrument.



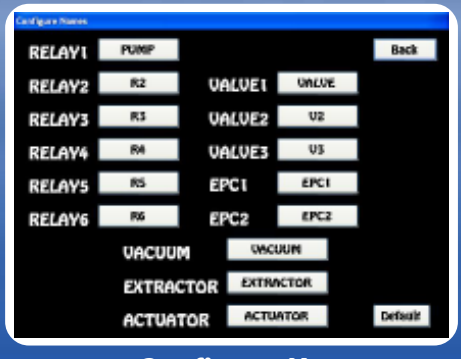
Run Status



Diagnostics



Plumbing



Configure Names

Specifications may change without notice.
01/2016

Mudlogging GC Specifications:

Electronics Module:
- Enter and store GC Methods via Color Touch Screen
- Actual and set-point display of all GC parameters
- Safety Limits on all user entered parameters
- Oven Temperature Programs (OTP) with Multiple Ramps
- Pressure Programs for Carrier Gases with Multiple Ramps
- Timeline for sequencing Relays and Valve
- Detector Control of all Parameters on one page
- Electronic Pressure Controllers (EPC's):
  Atmospheric Pressure & Temperature Compensation
  EPC Pressure Control with 0.1 kPa set-point resolution
- Plug and Play GC Control, Oven, and Detector Board
- Microprocessor Controlled
- Proprietary Digital Signal Processing
- Digital Signal Outputs for each Detector
- Universal voltage input (85 – 240 Vac) with line filter and breaker.

Detectors:
FID – Flame Ionization Detector (1 ppm detection limit, dependent on sample loop size)

- 400 °C Temperature Limit with 0.1 °C set-point resolution
- 24-bit Digital Outputs for the detector via USB
- EPC Pressure Control with 0.1 kPa set-point resolution

Column:
2m 20% OV-1

Results:
Automatically calibration corrected and reported

Series 600 Oven Module:
- Ambient to 400°C Column Oven
- Up to 100 °C per/min Oven Ramp
- Fast Cooldown 300 °C to 50 °C in 3.5 min
- 1000 watt total Heater Elements
- Temperature Ramps with 0.1 °C set-point resolution
- 23 x 23 x 20 cm area for Glass, SS, or Capillary Columns

Companion 2 Oven Module:
- Ambient to 325 °C Column Oven
- Up to 80 °C per/min Oven Ramp
- Fast Cooldown 300 °C to 50 °C < 4 min
- 200 watt Heater Element
- Temperature Ramps with 0.1 °C set-point resolution
- 12.5 x 10.5 x 12.5 cm area for Packed, or Capillary Columns
- 7 amps at 48 Vdc total power consumption

Built-In Accessories:
- Sample Valve - Electronically Actuated
- Heated Valve Oven
- Vacuum Pump
- Air Compressor for FID's
- Calibration Gas & Stream Selection Solenoid

Injector:
- Cool On-column Injectors
- Multiple Pressure Ramps with 0.1 kPa set-point resolution

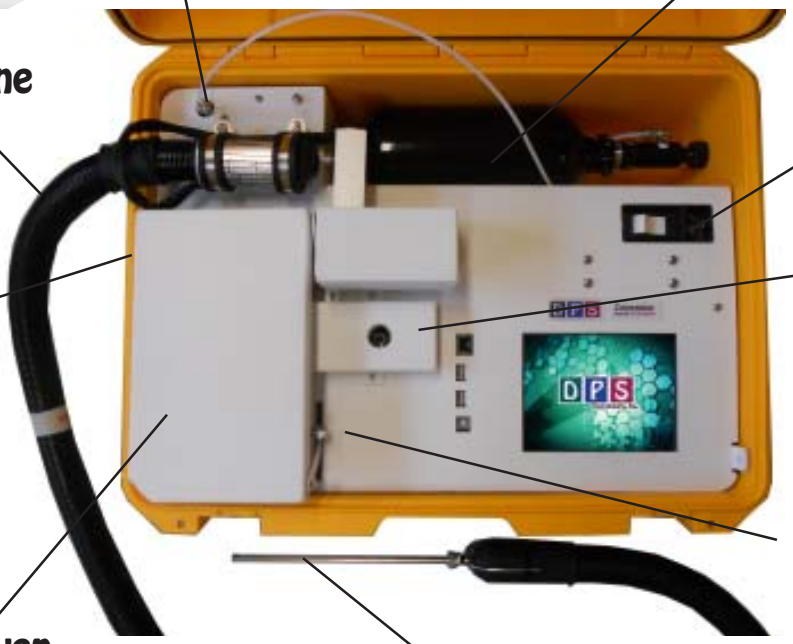
Data Communications:
- Bi-directional communication with popular Data System

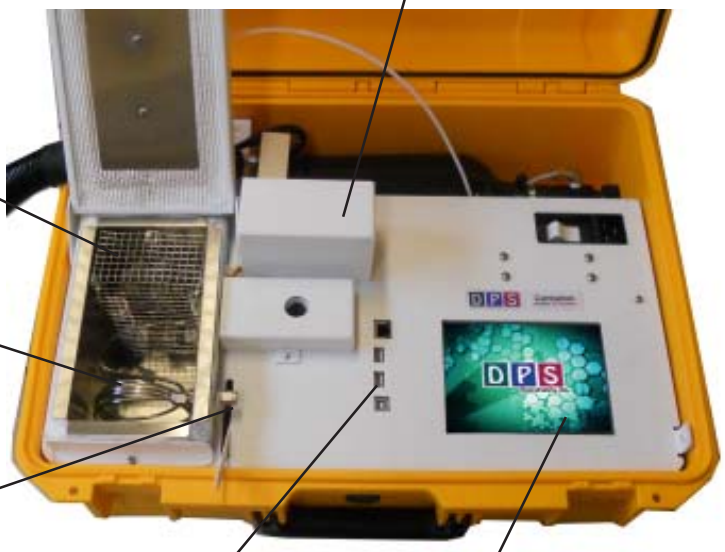
Network Connectivity:
- Enterprise Compatible Network GC running Windows XPe
- Ethernet Connection using Windows Network Protocol
- On Board ETX Computer for GC Control and Data Acquisition
- Remote Control of GC and Data Acquisition over LAN

Lab Quality Analyses in the Field,
"It Goes with you Anywhere!"

DPS Instruments, Inc.

DPS Companion Method 25 Layout

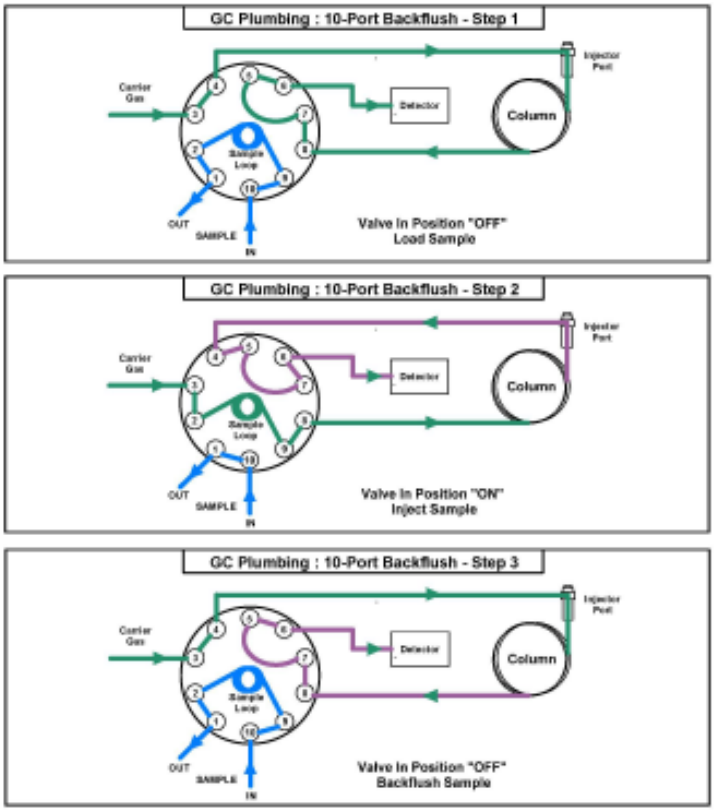




Plumbing Diagram

Load Air Sample: The vacuum pump draws the sample from the Transfer Line through the fixed Sample Loop to the pump to limit any possible cross contamination between samples. The entire sequence of the Method 25 GC Analyzer is automated through the Timeline of the DPS Control Software for the analysis of one sample, or the system can be set up to run unattended 24/7, collecting and analyzing samples every few minutes.

Backflush Configuration: With the Backflush plumbing configuration the sample is injected into the column by rotating the valve. The valve and sample lines are heated creating a inert sample path. When the compounds of interest have eluted from the column, the rest of the compounds can be Backflushed out of the column to the detector as one peak, which represents the total of all other compounds. For a Method 25 analysis Methane is allowed to elute form the column and then the valve is rotated back to Backflush all of the other compounds forming the non-Methane peak. Both Methane and non-Methane constituents are calibrated separately. By simply adjusting the time at which the valve rotates back, the analysis could be altered to separate Methane, Ethane and then a total of C3+ compounds. Using the same technique the valve can be rotated to Backflush after any carbon group C1, C2, C3, C4, C5 etc.



Backflush Plumbing Diagram

Results, Data & Conncetivity

Results: The Results can be saved for each sample, or they can be printed, or they can be tabulated into a .LOG file, when you are collecting a vast amount of data over a long time period. The format of the. LOG file is text, so it can be opened by any word processing program.

Data and Connectivity: The built-in computer is used to collect and store the data. Data can also be copied to a USB Stick to transfer to another computer. Data can be transferred from the built-in computer to another computer on the LAN through the Ethernet port using standard Windows protocols. Or, we can use a USB cable to connect the GC to the remote computer where the data can be collected and stored on that hard drive.

Method 25 GC Specifications:

Electronics Module:
- Enter and store GC Methods via Color Touch Screen
- Actual and set-point display of all GC parameters
- Safety Limits on all user entered parameters
- Oven Temperature Programs (OTP) with Multiple Ramps
- Pressure Programs for Carrier Gases with Multiple Ramps
- Timeline for sequencing Relays and Valve
- Detector Control of all Parameters on one page
- Electronic Pressure Controllers (EPC's):
  Atmospheric Pressure & Temperature Compensation
  EPC Pressure Control with 0.1 kPa set-point resolution
- Plug and Play GC Control, Oven, and Detector Board
- Microprocessor Controlled
- Proprietary Digital Signal Processing
- Digital Signal Outputs for each Detector
- Universal voltage input (85 – 240 Vac) with line filter and breaker.

Detectors:
FID – Flame Ionization Detector

- 400 °C Temperature Limit with 0.1 °C set-point resolution
- 24-bit Digital Outputs for the detector via USB
- EPC Pressure Control with 0.1 kPa set-point resolution

Columns:
Packed, or Capillary Columns

Results:
Automatically calibration corrected and reported

Series 600 Oven Module:
- Ambient to 400°C Column Oven
- Up to 100 °C per/min Oven Ramp
- Fast Cooldown 300 °C to 50 °C in 3.5 min
- 1000 watt total Heater Elements
- Temperature Ramps with 0.1 °C set-point resolution
- 23 x 23 x 20 cm area for Glass, SS, or Capillary Columns

Companion Oven Module:
- Ambient to 325 °C Column Oven
- Up to 80 °C per/min Oven Ramp
- Fast Cooldown 300 °C to 50 °C < 4 min
- 200 watt Heater Element
- Temperature Ramps with 0.1 °C set-point resolution
- 12.5 x 10.5 x 12.5 cm area for Packed, or Capillary Columns
- 7 amps at 48 Vdc total power consumption

Built-In Accessories:
- Backflush Sample Plumbing
- Heated Transfer Line
- Air Compressor for FID

Injectors:
- Heated On-column Injector
- Multiple Pressure Ramps with 0.1 kPa set-point resolution

Data Communications:
- Bi-directional communication with popular Data System

Network Connectivity:
- Enterprise Compatible Network GC running Windows XPe
- Ethernet Connection using Windows Network Protocol
- On Board ETX Computer for GC Control and Data Acquisition
- Remote Control of GC and Data Acquisition over LAN

Lab Quality Analyses in the Field,

"It Goes with you Anywhere!"

DPS Instruments, Inc.

Micro-TCD GC Applications

Transformer Oil Gas Analysis - TOGA

The DPS Micro-TCD TOGA GC System is designed to analyze oil from electrical insulation materials that may have decomposed under thermal, or electrical stresses following ASTM 3612C for gas analysis using headspace injection. The gaseous decomposition products indicate the type of fault inside the transformer.

The DPS Micro-TCD TOGA GC System separates all 11 components in one injection; Hydrogen, Oxygen, Nitrogen, Methane, Carbon Monoxide, Ethane, Carbon Dioxide, Ethylene, Propane, Acetylene, and Propylene. All compounds are detected to 1ppm with the ultra-sensitive Micro-TCD Detector (Micro-machined Thermal Conductivity Detector) in less than 2 minutes.

The headspace sample is heated and stirred by the 42 vial Autosampler prior to injection into the 2 channel TOGA GC System. The 1st Channel separates the permanent gases and the 2nd Channel separates the C2-C3 hydrocarbons and CO2. With the 6 heating chamber oven, the Autosampler can inject a sample every 5 min, making this the fastest TOGA analyzer ever.

The combined power of a 42 vial Dynamic Headspace Autosampler and the rugged and versatile DPS Micro-TCD GC make this routine analysis quick and easy.

Micro-TCD TOGA GC System
Permanent Gases &
Light Hydrocarbons
Dissolved in oil!

Powerful Combination

Headspace Autosampler

Micro-TCD GC System

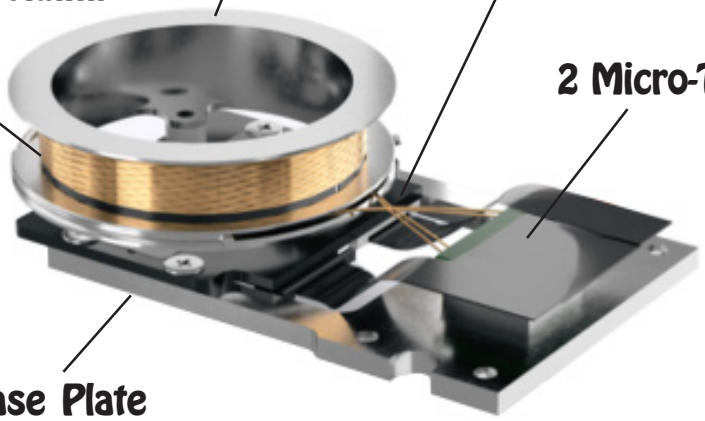
General Specifications:

- Micro-TCD Gas Chromatograph
- 42 Vial Headspace Autosampler
- TOGA analysis in less than 2 min
- 2 Channels - GC Column Oven/Micro-TCD´s
- Fast & Accurate with Low Maintenance
- Easy Chromatography Data System
- Ultra Compact and Lightweight,
  GC (20 x 15 x 10 cm), approximately 8 kg
  AS (33 x 64 x 32 cm), approximately 10 kg

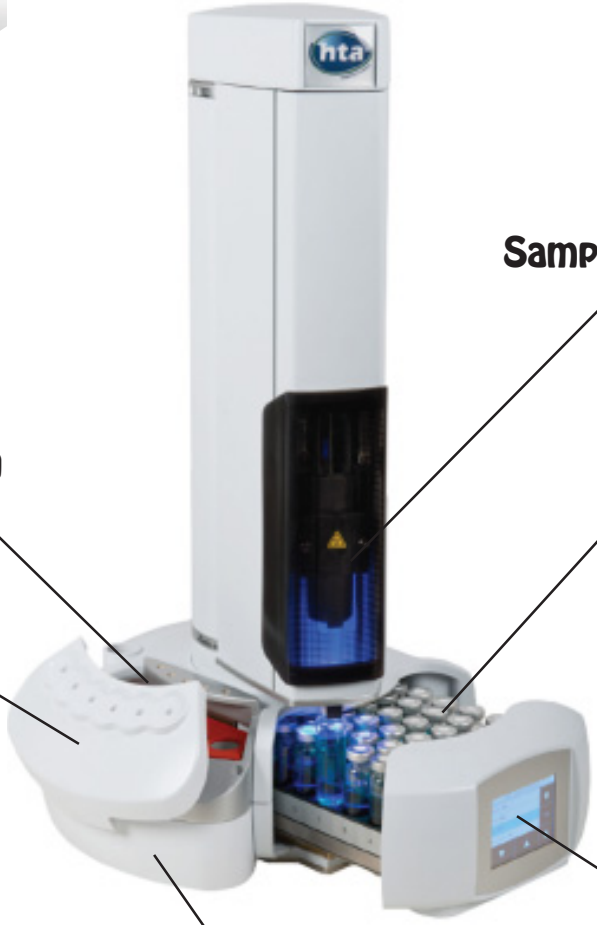
DPS Instruments, Inc.

DPS Micro-TCD GC Layout

DPS Micro GC Channel



Dynamic Headspace Autosampler

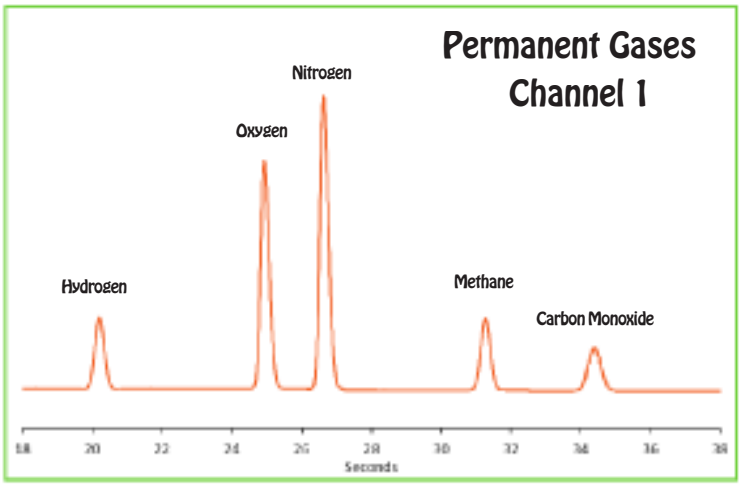


Top View

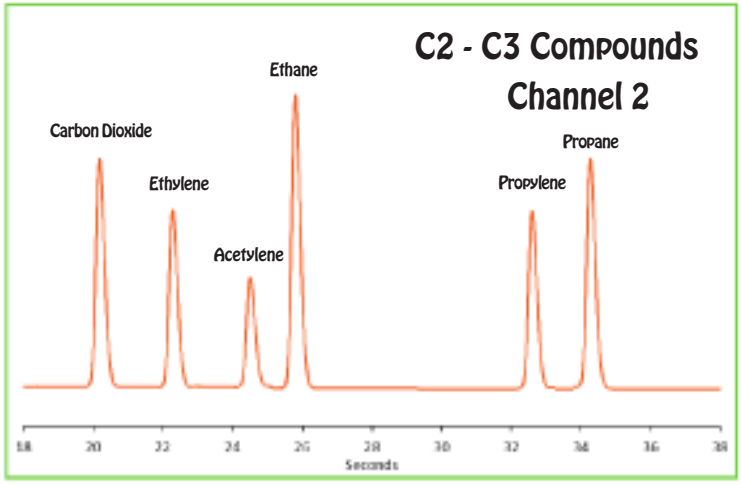
DPS Micro-TCD TOGA GC System

Channel 1 - A Molecúlar Sieve column is used to separate the Permanent Gas components: Hydrogen, Oxygen, Nitrogen, Methane & Carbon Monoxide using helium as a carrier gas.

After the compounds elute we back-flush the pre-column to keep the Molecular Sieve free of heavier compounds.



Channel 2 - A BOND column is used to separate the C2 - C3 Gas components: Ethane, Carbon Dioxide, Ethylene, Propane, Acetylene & Propylene using helium as a carrier gas.



DPS Micro-TCD TOGA GC Features

System Configuration - A Simple and efficient configuration combining the power of the rugged Micro-TCD GC with 2 Channels and versatile 42 vial Dynamic Headspace Autosampler. Each Channel contains a GC Oven, Analytical Column, Pre-Column, 2 Micro-TCD Detectors, Injection Valve, Back-Flush valve and Electronic & Gas Connections.

Sample Information - The eleven most common compounds are included in this analysis scheme which meets ASTM-D3612C methodology. The compounds included in this method are H2, O2, N2, CH4, CO, C2H6, CO2, C2H4, C2H2, C3H6, and C3H4. The results from the analysis of these compounds helps target the underlying fault condition of the transformer. The action levels indicate the concentration levels where the falut is severe and action should be taken to mitigate any possible dangerous situation.

Micro-TCD - Parts per Million (ppm)

No.	Compound	DL	Action Level
1	Hydrogen	1-5**	100-500
2	Oxygen	1	NA
3	Nitrogen	1	NA
4	Methane	1	100-400
5	Carbon Monoxide	1	100-1000
6	Ethane	1	100-400
7	Carbon Dioxide	1	150-3000
8	Ethylene	1	500-2000
9	Propane	1	100-500
10	Acetylene	1	100-400
11	Proplyene	1	100-500

** **Hydrogen** - For the lowest possible Hydrogen Detection Limit a 3rd Channel can be addded to the system specifically for Hydrogen and Nitrogen would be used as the carrier gas, instead of Helium.

Specifications may change without notice.
02/2023

DPS Micro-TCD TOGA GC System Specifications:

Micro-TCD GC:

Micro GC Channels:
- 2 Micro GC Channels in an Exchangeable Cartridge
- Each GC Channel contains GC Oven, Analytical Column,
  Pre-Column, 2X Micro-TCD Detectors, Injection and

Software/GC Control Interface:
- Enter and store GC Methods via Computer connection
- Safety Limits on all user entered parameters
- Communications: RS232, RS485, Ethernet, Digital I/O
- Protocols: Modbus, TCP
- Sequencing for Sampling, Injection, Backflush, etc.
- Memory Storage - up to 256Gb
- Control for Carrier Gas(s)
- Control for Valves (Injection, Backflush, Sample)
- Universal voltage input (85 – 240 Vac, 50-60Hz)
- Power Supply - (20 – 28 Vdc)

Features:
- 150 °C Temperature Limit with 0.1 °C set-point resolution
- Isothermal Operation
- Repeatability - < 0.05% RSD
- Cycle Time (Typical) - 60 sec
- Detection Limit (500ppb - 100%)
- Sequence Controlled Injection Time
- 1 Micro-machined Injector per Channel
- 1 Pre-Column with Backflush per Channel
- 1 Analytical Column per Channel
- Dimensions: 20 x 15 x 10 cm
- Weight: 10.0kg

Headspace Autosampler:

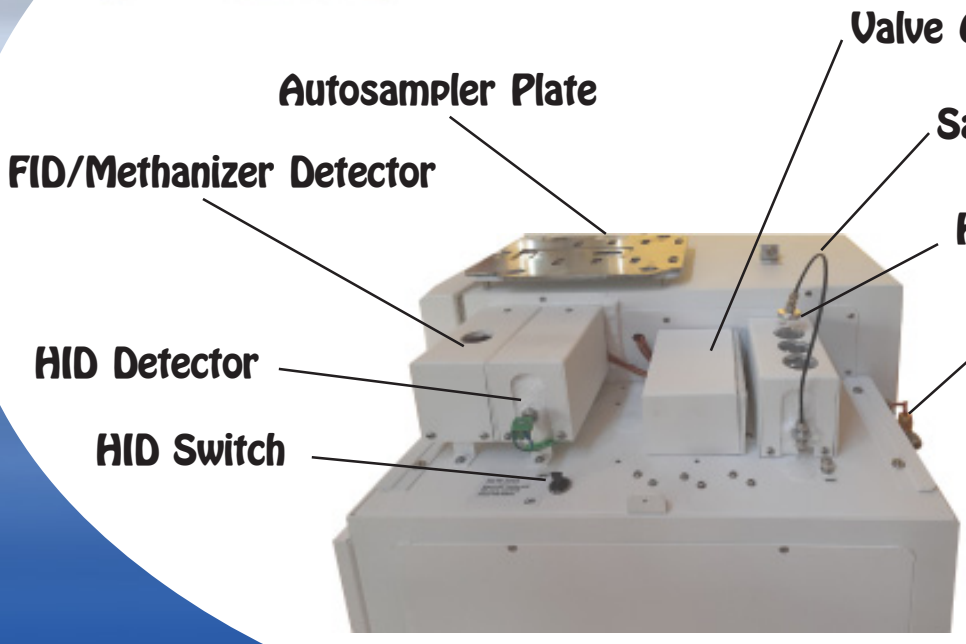
Features:
- Sampling: 42 Vials 20ml Headspace
- 2X Sample Probes
- Pull Up Strokes: Up to 15 Strokes
- Filling Speed: 0.5 - 100ml/min
- Time between Samples: 0 - 100 mins
- Shaking Method: Orbital
- Incubation Oven: 6 position
- Incubation Time: 0 - 999 mins
- Oven Temperature: 40 - 170C
- Shaker Speed: Very Low to Very High
- Shaking Cycles: 0 - 9.9 mins
- Probe Injection Depth: Varaible
- Electrical Control: LAN & TTL
- Dimensions: 330 x 640 x 320mm
- Weight: 10.0kg
- Power Supply: 100-240VAC, 50-60Hz

Headspace Autosampler

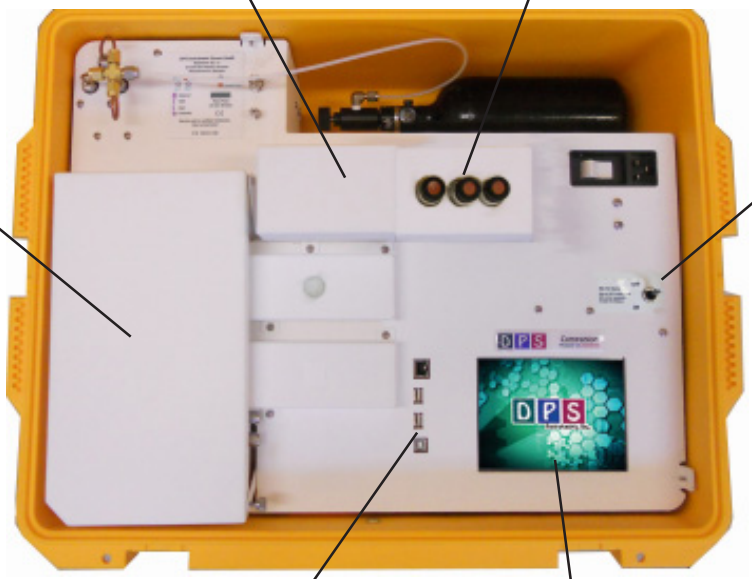
Micro-TCD GC System

Transformer Oil Gas Analysis - TOGA

DPS Series 600 TOGA Layout



DPS Companion 2 TOGA Layout



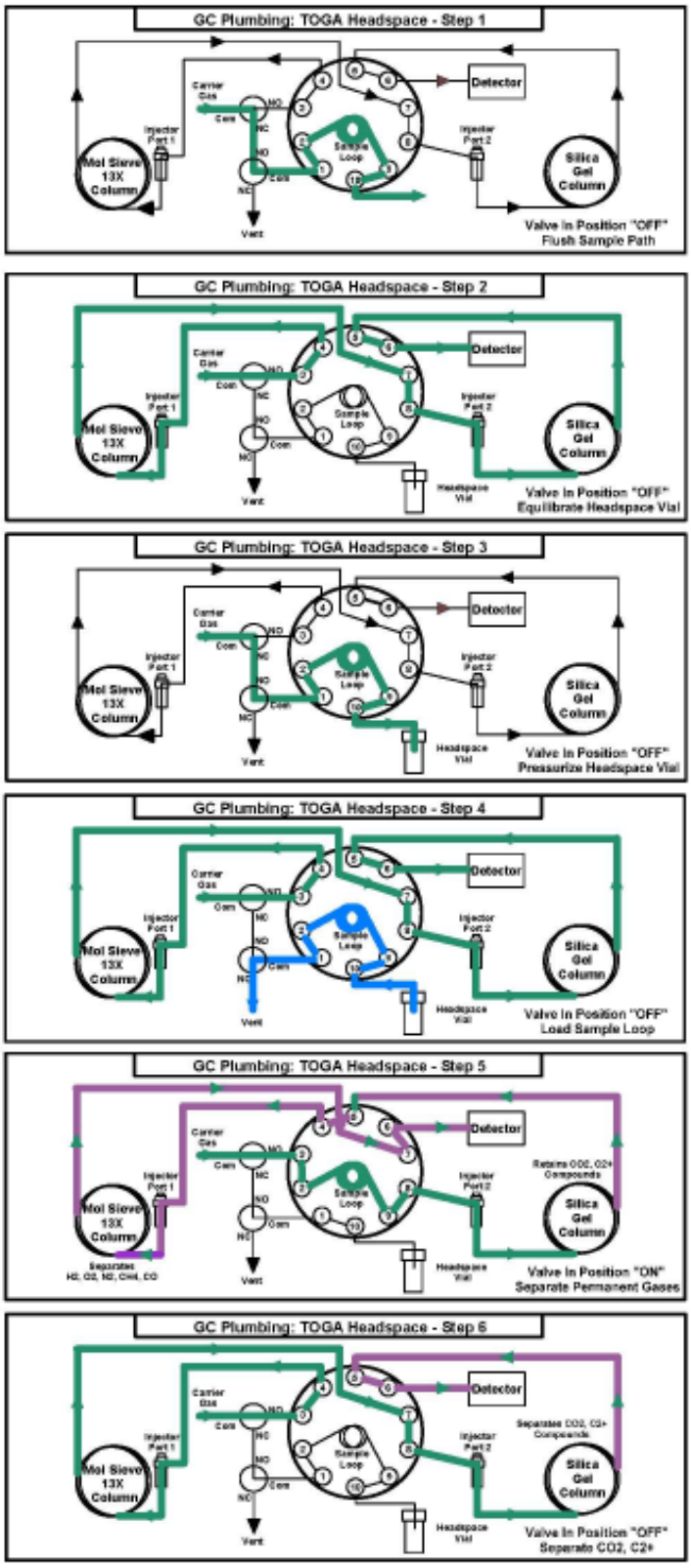
TOGA Plumbing Diagram

TOGA Headspace Concentrator - The Headspace Concentrator for Companion GC's are built right in to provide the shortest possible sample path. The Sample Vial is heated and then consistently Pressurized before loading the Sample Loop. A fixed Sample Loop ensures reproducible sampling and the sample lines are Flushed between analyses to limit any cross over contamination. The entire sequence of the Headspace Concentrator is automated through the Timeline sequence of the DPS GC Control Software for the analysis of one sample at a time, while two other samples are heated to equilibrate.

TOGA Plumbing Diagram - In the 1st Step the carrier gas is diverted to Flush out the Sample Lines between runs. During the 2nd Step the carrier gas flows to the analytical column and the Headspace Vial is heated with the Vial Heater and allowed to equilibrate. The Sample Probe is then inserted into the Headspace Vial. During the 3rd Step the Headspace Vial is pressurized for a few seconds. In the 4th Step the sample is loaded onto the Sample Loop by releasing the pressure in the headspace vial. In the 5th Step the Sample Valve is rotated to the ON position and the carrier gas sweeps the components from the Sample Loop onto the analytical columns.

TOGA Column Configuration - The unique 2 column configuration simplifies the compound separation and analysis of the TOGA Headspace sample. The columns are plumbed in series through the same Sample Valve as the Headspace Concentrator.

In Step 5 the Sample Valve is rotated to Inject the sample onto the analytical columns. The Silica Gel column retains CO2 & the C2+ hydrocarbons, while the lighter compounds (H2, O2, N2, CH4, & CO) pass through and are further separated on the Molecular Sieve column. Once the lighter compounds have been separated the valve is rotated back in Step 6 and the heavier compounds (CO2 & C2+ hydrocarbons) are separated on the Silica Gel column.



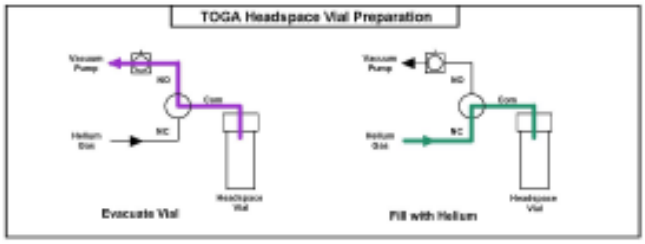
TOGA Headspace Plumbing Diagram

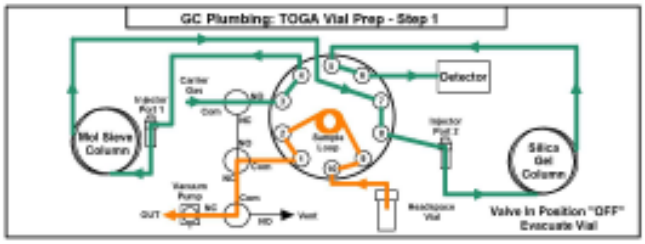
Vial Preparation Station

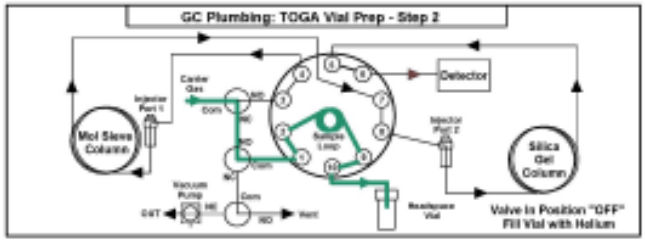
Clean Headspace Vials - One of the most difficult parts of the TOGA analyses is the sampling proceedure. The first step is taking a gas tight syringe and inserting the needle under the sureface of the oil to get a representative sample. The second step in injecting the oil into a clean vial. If either step is not sucessful, then you will see Oxygen and Nitrogen contamination from the air.

To insure that the sample vial is clean we have built in a Vial Preparation Station. Using the same technique that cylinder manufacturers employ to clean gas cylinders between uses; we evacuate, then re-fill the vial with helium several times to reduce Oxygen and Nitrogen to low ppm levels. The helium comes from the same supply as the carrier gas. A 2nd Method is loaded in the DPS Software to automatically clean the vials. The sample probe is inserted through the septum and the START button is pressed. The vials are prepared one at a time, but several can be prepared at once to be used throughout the day.

Plumbing Diagram - The first diagram is simplified to show that we evacuate and re-fill the vial using carrier gas. The 2nd diagram is the atual plumbing configuration when the Vial Preparation Station is connected to the rest of the TOGA plumbing.





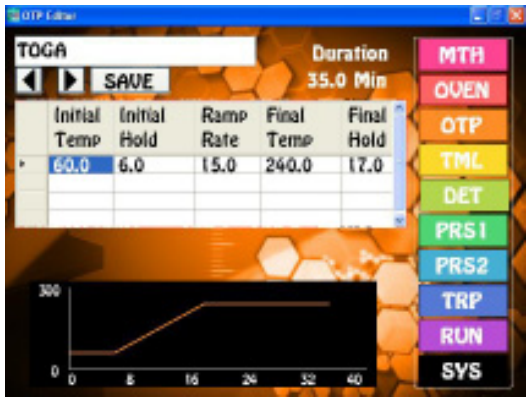


TOGA Vial Preparation Diagrams

TOGA GC Control Software

Easy to learn and master using a Graphical User Interface (GUI) and Color Touch Screen.

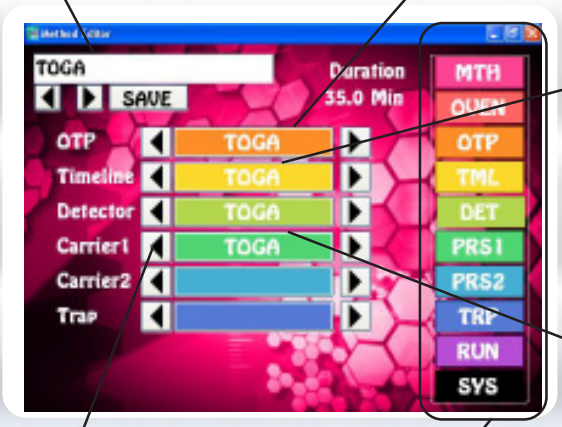
Editors let you customize the files associated with the GC Method.



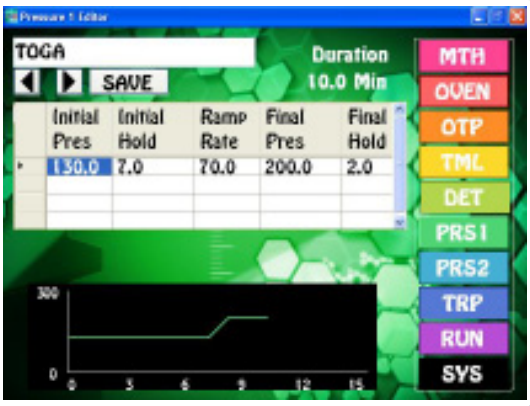
Oven Temp Program Editor

Timeline Editor

Method Name



File Selection Arrows



Carrier Pressure 1 Editor

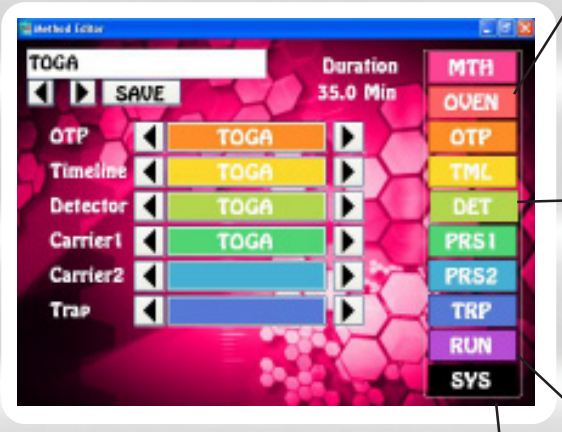
Navigation Buttons to Quickly jump from one screen to another. Most pages are one button away!

Keyboard to Enter Filenames

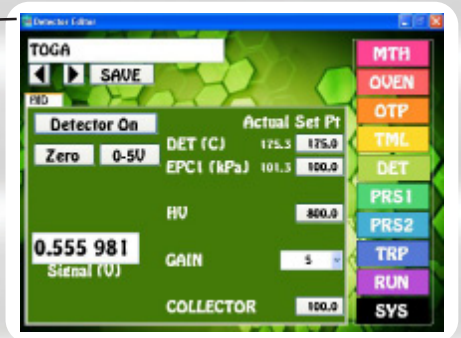
Number Pad for entering Values

GC Status pages display the parameters in the method, both graphically and as text and values.

Oven Status

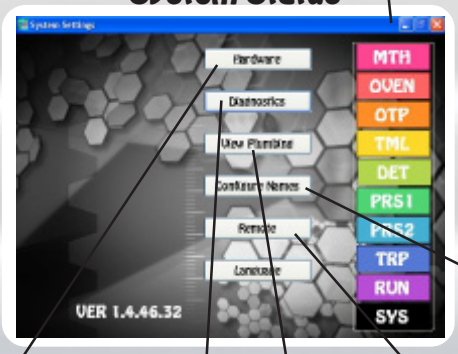


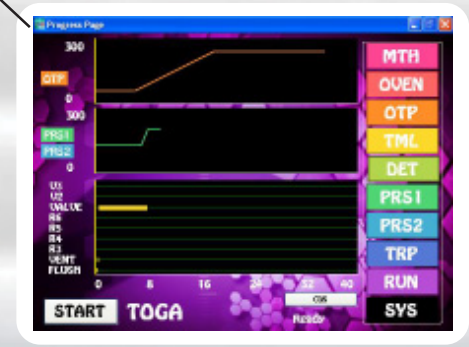
Method Editor



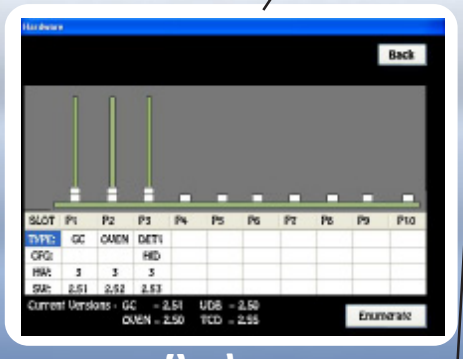
Detector Status

System Status



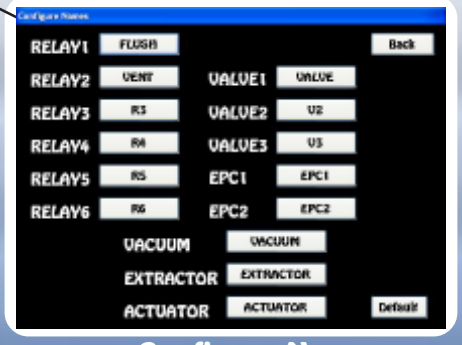


Run Status

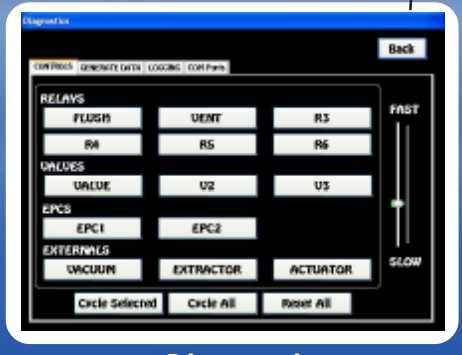


Hardware

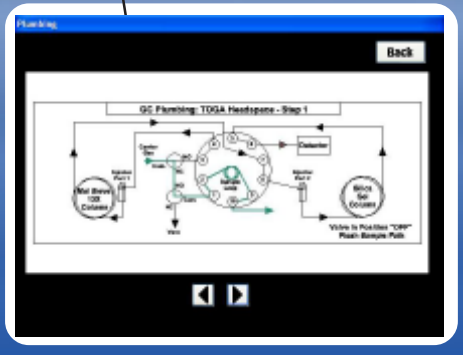
System status pages display the health and viability of the GC instrument.

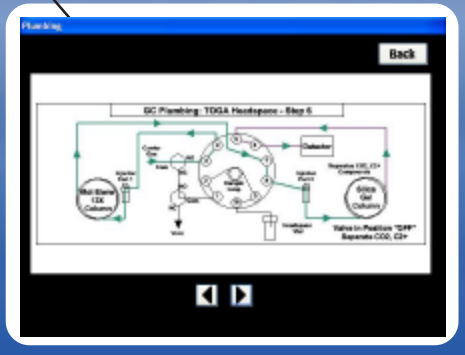


Configure Names



Diagnostics





Plumbing - Steps 1...6

TOGA Gas Chromatograph Features

System Configuration - A Simple and efficient configuration using two packed columns, one valve, and a single HID Detector, or the HID in series with a FID/Methanizer The Silica Gel column separates all of the compounds except it has trouble with the permanent gases. To solve this problem, we have added a Molecular Sieve column in series with the Silica Gel column to separate the permanent gases. Once they are separated we switch the valve back to take the Molecular Sieve column out of the sample path and let the remaining compounds travel through the Silica Gel column to the HID detector.

Sample Information - The eleven most common compounds are included in this analysis scheme which meets ASTM-D3612C methodology. The compounds included in this method are H2, O2, N2, CH4, CO, C2H6, CO2, C2H4, C2H2, C3H6, and C3H4. The results from the analysis of these compounds helps target the underlying fault condition of the transformer. The action levels indicate the concentration levels where the falut is severe and action should be taken to mitigate any possible dangerous situation.

Parts per Million (ppm)

No.	Compound	HID Detection Limit	FID/Methanizer Detection Limit	Action Level
1	Hydrogen	50	NA	100-500
2	Oxygen	10	NA	NA
3	Nitrogen	10	NA	NA
4	Methane	10	1	100-400
5	Carbon Monoxide	10	1	100-1000
6	Ethane	10	1	100-400
7	Carbon Dioxide	10	1	150-3000
8	Ethylene	10	1	500-2000
9	Propane	10	1	100-500
10	Acetylene	10	1	100-400
11	Proplyene	10	1	100-500

Headspace Accessory - The built-in headspace vial accessory, including vial heater, sample valve, pressure and vent solenoids, and sampling probe help automate the TOGA analysis in either the Companion or Series 600 GC TOGA Systems. The pre-purged vial containing the oil sample is heated and allowed to equilibrate in the vial heater prior to analysis. There are positions for 3 vials, so once the first has equilibrated, the analysis can proceed one sample after another. The analysis is only manual as far as the user needs to insert the sample probe into the headspace vial. The remainder of the analysis sequence is automated.

Headspace Autosampler - For a completely automated TOGA System the Series 600 GC can be equipped with a Headspace Autosampler with a 42 vial capacity. The Series 600 TOGA GC and autosampler work in unison to auotmate vial preparation, oil analysis, and reporting.

TOGA GC Specifications:

Electronics Module:

- Enter and store GC Methods via Color Touch Screen
- Actual and set-point display of all GC parameters
- Safety Limits on all user entered parameters
- Oven Temperature Programs (OTP) with Multiple Ramps
- Pressure Programs for Carrier Gases with Multiple Ramps
- Timeline for sequencing Relays and Valve
- Detector Control of all Parameters on one page
- Electronic Pressure Controllers (EPC's):
  Atmospheric Pressure & Temperature Compensation
  EPC Pressure Control with 0.1 kPa set-point resolution
- Plug and Play GC Control, Oven, and Detector Board
- Microprocessor Controlled
- Proprietary Digital Signal Processing
- Digital Signal Outputs for each Detector
- Universal voltage input (85 – 240 Vac) with line filter and breaker.

Detector:

HID – Helium Ionization Detector (10 ppm detection limit)
FID – Flame Ionization Detector (1 ppm detection limit)
Methanizer - Converts CO & CO2 to Methane (1ppm DL)

- 400 °C Temperature Limit with 0.1 °C set-point resolution
- 24-bit Digital Outputs for the detector via USB
- EPC Pressure Control with 0.1 kPa set-point resolution

Columns:

Molecular Sieve
Silica Gel

Results:

Automatically calibration corrected and reported in % or ppm

Series 600 Oven Module:

- Ambient to 400°C Column Oven
- Up to 100 °C per/min Oven Ramp
- Fast Cooldown 300 °C to 50 °C in 3.5 min
- 1000 watt total Heater Elements
- Temperature Ramps with 0.1 °C set-point resolution
- 23 x 23 x 20 cm area for Glass, SS, or Capillary Columns

Companion 2 Oven Module:

- Ambient to 325 °C Column Oven
- Up to 80 °C per/min Oven Ramp
- Fast Cooldown 300 °C to 50 °C < 4 min
- 200 watt Heater Element
- Temperature Ramps with 0.1 °C set-point resolution
- 12.5 x 10.5 x 12.5 cm area for Packed, or Capillary Columns
- 7 amps at 48 Vdc total power consumption

Built-In Accessories:

- Sample Valve - Electronically Actuated
- Heated Valve Oven
- Headspace Concentrator
- Headspace Vial Prep Station
- Flow Control Solenoids

Injector:

- Heated On-column Injector
- Multiple Pressure Ramps with 0.1 kPa set-point resolution

Data Communications:

- Bi-directional communication with popular Data System

Network Connectivity:

- Enterprise Compatible Network GC running Windows XPe
- Ethernet Connection using Windows Network Protocol
- On Board ETX Computer for GC Control and Data Acquisition
- Remote Control of GC and Data Acquisition over LAN

Lab Quality Analyses in the Field,
"It Goes with you Anywhere!"

DPS Instruments, Inc.

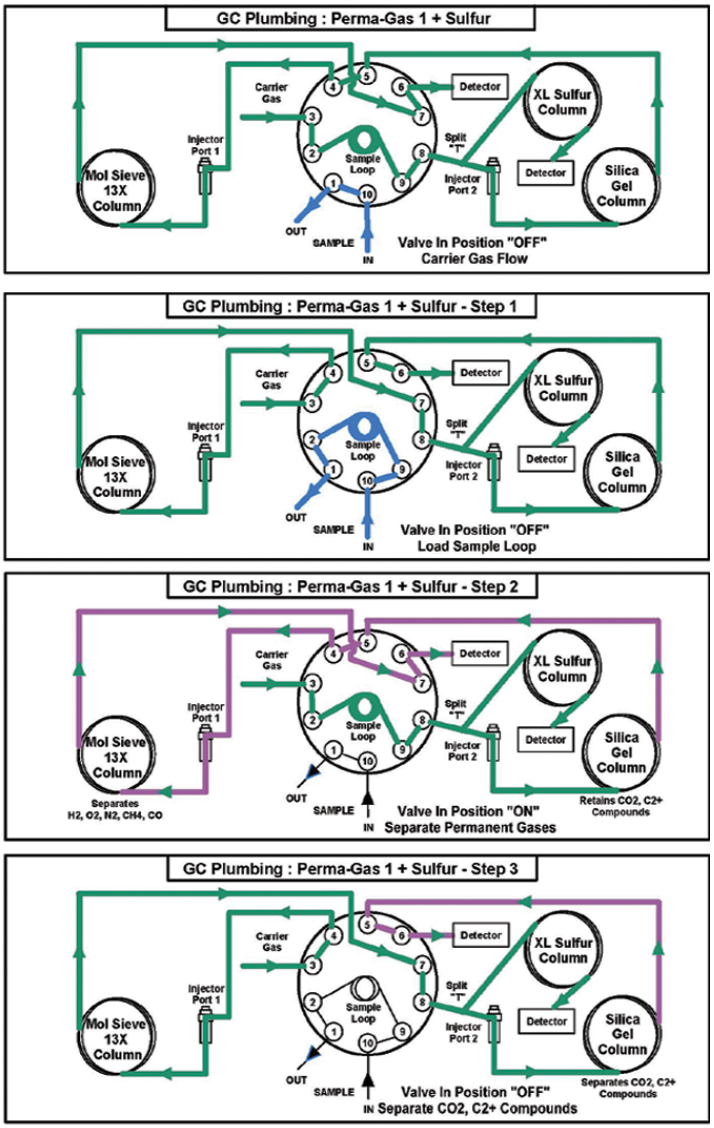
DPS Companion 2 Perma-Gas + Sulfur GC Layout

Plumbing Diagram

Sample Analysis - The Gas Sample Valve and heated Valve Oven for the Companion GC's are built right in to provide the shortest possible sample path. The Sample Line is connected to the Valve Oven and from there all of there the entire sample path is heated to limit possible carry over. A fixed Sample Loop ensures reproducible sampling and is Flushed between analyses. The sampling and analysis sequence is automated through the Timeline of the DPS GC Control Software. The analysis can be set up to run unattended 24/7 collecting, processing, and storing all of the data.

The unique 2 column configuration simplifies the compound separation and analysis. The columns are plumbed in series through the heated Sample Valve.

Plumbing Diagram - In the 1st Step the sample is loaded on the Sample Loop with the built-in vacuum pump. During Step 2 the Sample Valve is rotated to Inject the sample simultaneously onto the Silica Gel and XL-Sulfur analytical columns. The XL-Sulfur separates the Sulfur compounds,which are detected by the PID detector down into the ppb range. The Silica Gel column retains CO2 & the C2+ hydrocarbons, while the lighter compounds (H2, O2, N2, CH4, & CO) pass through and are further separated on the Molecular Sieve column. Once the lighter compounds have been separated the valve is rotated back in Step 3 and the heavier compounds (CO2 & C2+ hydrocarbons) are separated on the Silica Gel column.



Perma-Gas + Sulfur Plumbing Diagram

Results, Data & Connectivity

Results: The results and chromatogram are stored on the hard drive. Additionally, for each channel a log file summary of the compounds detected is a convenient way of looking at large amounts of data collected over time.

Data and Connectivity: The built-in computer is used to collect and store the data. Data can also be copied to a USB Stick to transfer to another computer. Data can be transferred from the built-in computer to another computer on the LAN through the Ethernet port using standard Windows protocols. Or, we can use a USB cable to connect the GC to the remote computer where the data can be collected and stored on that hard drive.

GC Control Software

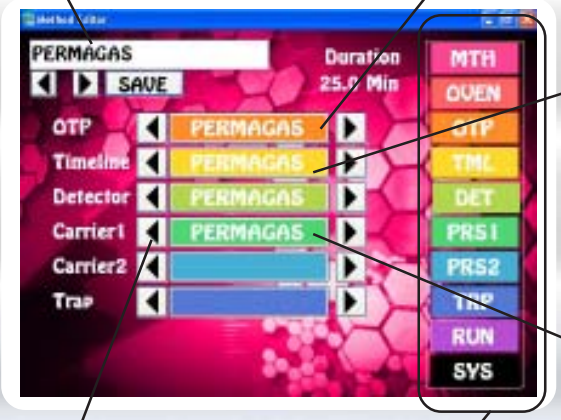
Easy to learn and master using a Graphical User Interface (GUI) and Color Touch Screen.

Editors let you customize the files associated with the GC Method.

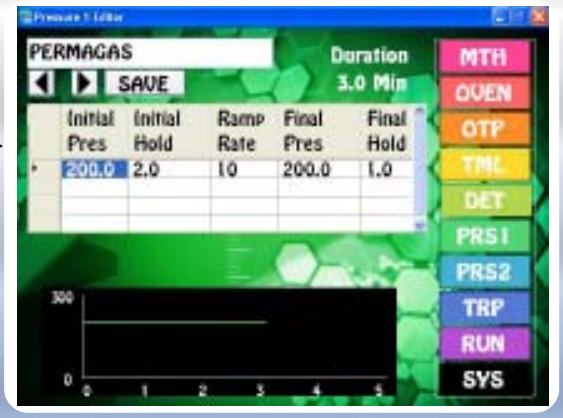
Oven Temp Program Editor

Timeline Editor

Method Name



File Selection Arrows



Carrier Pressure 1 Editor

Navigation Buttons to Quickly jump from one screen to another. Most pages are one button away!

Keyboard to Enter Filenames

Number Pad for entering Values

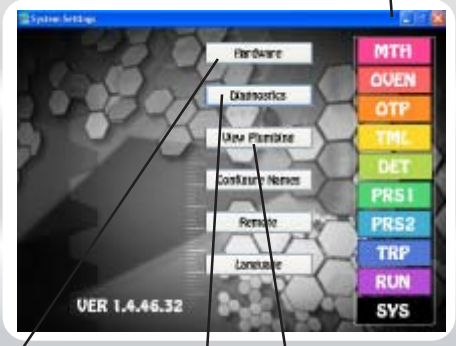
GC Status pages display the parameters in the method, both graphically and as text and values.

Oven Status

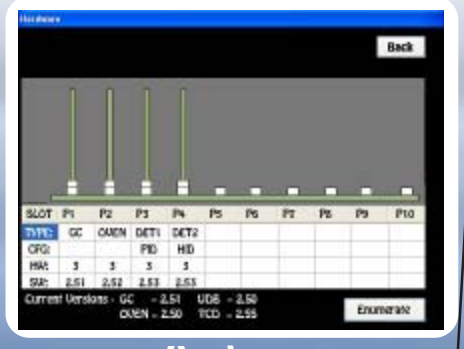
Method Editor

PID Detector Status

System Status

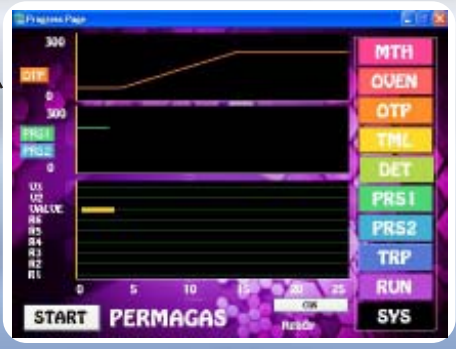


HID Detector Status

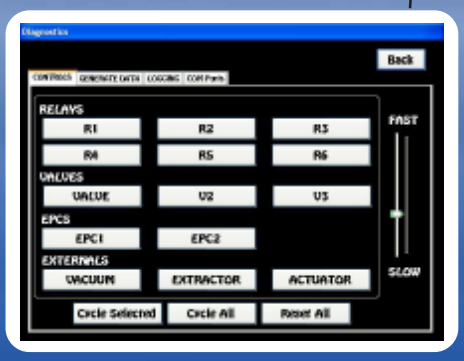


Hardware

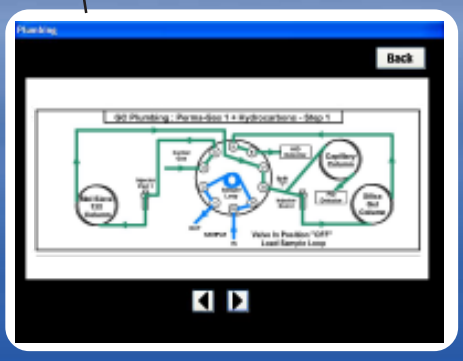
System status pages display the health and viability of the GC instrument.



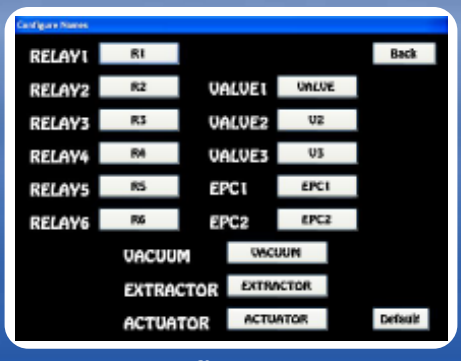
Run Status



Diagnostics



Plumbing



Configure Names

Specifications may change without notice.
01/2016

Perma-Gas + Sulfur GC Specifications:

Electronics Module:
- Enter and store GC Methods via Color Touch Screen
- Actual and set-point display of all GC parameters
- Safety Limits on all user entered parameters
- Oven Temperature Programs (OTP) with Multiple Ramps
- Pressure Programs for Carrier Gases with Multiple Ramps
- Timeline for sequencing Relays and Valve
- Detector Control of all Parameters on one page
- Electronic Pressure Controllers (EPC's):
  Atmospheric Pressure & Temperature Compensation
  EPC Pressure Control with 0.1 kPa set-point resolution
- Plug and Play GC Control, Oven, and Detector Board
- Microprocessor Controlled
- Proprietary Digital Signal Processing
- Digital Signal Outputs for each Detector
- Universal voltage input (85 – 240 Vac) with line filter and breaker.

Detector:
HID – Helium Ionization Detector (10 ppm detection limit)
PID – Photoionization Detector (100ppb detection limit)
(dependent on sample loop size)

- 400 °C Temperature Limit with 0.1 °C set-point resolution
- 24-bit Digital Outputs for the detector via USB
- EPC Pressure Control with 0.1 kPa set-point resolution

Columns:
1m Molecular Sieve, 2m Silica Gel, 2m Micro-packed

Results:
Automatically calibration corrected and reported

Series 600 Oven Module:
- Ambient to 400°C Column Oven
- Up to 100 °C per/min Oven Ramp
- Fast Cooldown 300 °C to 50 °C in 3.5 min
- 1000 watt total Heater Elements
- Temperature Ramps with 0.1 °C set-point resolution
- 23 x 23 x 20 cm area for Glass, SS, or Capillary Columns

Companion 2 Oven Module:
- Ambient to 325 °C Column Oven
- Up to 80 °C per/min Oven Ramp
- Fast Cooldown 300 °C to 50 °C < 4 min
- 200 watt Heater Element
- Temperature Ramps with 0.1 °C set-point resolution
- 12.5 x 10.5 x 12.5 cm area for Packed, or Capillary Columns
- 7 amps at 48 Vdc total power consumption

Built-In Accessories:
- Sample Valve - Electronically Actuated
- Heated Valve Oven
- Vacuum Pump
- Calibration Gas & Stream Selection Solenoid

Injector:
- Heated On-column Injectors
- Multiple Pressure Ramps with 0.1 kPa set-point resolution

Data Communications:
- Bi-directional communication with popular Data System

Network Connectivity:
- Enterprise Compatible Network GC running Windows XPe
- Ethernet Connection using Windows Network Protocol
- On Board ETX Computer for GC Control and Data Acquisition
- Remote Control of GC and Data Acquisition over LAN

Lab Quality Analyses in the Field,
"It Goes with you Anywhere!"

DPS Instruments, Inc.